



Exmouth Gulf Prawn Fishery



Department of
Fisheries



Ecologically
Sustainable Development

Catching Sustainability

FRDC – Subprogram



Australian Government
Fisheries Research and
Development Corporation



Fish for the future

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Table of contents

1.0	Introduction.....	7
2.0	Overview	9
3.0	Background on the Exmouth Gulf Prawn Fishery.....	12
3.1	DESCRIPTION OF THE FISHERY	12
3.2	BIOLOGY OF WESTERN KING PRAWNS.....	21
3.3	BIOLOGY OF BROWN TIGER PRAWNS.....	22
3.4	BIOLOGY OF ENDEAVOUR PRAWNS.....	24
3.5	BIOLOGY OF BANANA PRAWNS.....	25
3.6	MAJOR ENVIRONMENTS.....	25
3.6.1	Physical environment	25
3.6.2	Economic environment	26
3.6.3	Social environment	26
4.0	Outline of reporting process.....	27
4.1	SCOPE.....	27
4.2	OVERVIEW.....	27
4.3	ISSUE IDENTIFICATION (COMPONENT TREES).....	28
4.4	RISK ASSESSMENT/PRIORITISATION PROCESS.....	29
4.5	COMPONENT REPORTS.....	30
4.6	APPLICATION TO MEET EPBCA REQUIREMENT	31
4.7	OVERVIEW TABLE.....	32
5.0	Performance reports	36
5.1	RETAINED SPECIES	36
5.1.1	Primary species.....	36
5.1.1.1	Tiger prawns.....	36
5.1.1.2	King prawns	41
5.1.1.3	Endeavour prawns.....	45
5.1.1.4	Banana prawns	47
5.1.2	By-product species.....	50
5.1.2.1	Coral prawns	50
5.1.2.2	Blue Swimmer crabs	52
5.1.2.3	Squid and cuttlefish	53
5.1.2.4	Sharks	54
5.1.2.5	Bugs	54
5.1.2.6	Cobia	54
5.1.2.7	Cods.....	55
5.1.2.8	Mackerel	55
5.1.2.9	Nor-west snapper.....	55
5.1.2.10	Other species.....	55

5.2	NON-RETAINED SPECIES	56
5.2.1	Captured in nets.....	56
5.2.1.1	Protected species – seasnakes	56
5.2.1.2	Protected species – Syngnathids	57
5.2.1.3	Protected species – Leatherback turtles.....	57
5.2.1.4	Threatened/listed species – Green turtles	58
5.2.1.5	Threatened/listed species – Loggerhead turtles.....	58
5.2.1.6	Threatened/listed species – Flatback turtles	59
5.2.1.7	Threatened/listed species – Hawksbill turtles.....	59
5.2.1.8	Discarded fish	60
5.2.1.9	Invertebrate species	62
5.2.2	Interaction but no capture	63
5.2.2.1	Protected species – Dugongs and cetaceans.....	63
5.2.2.2	Protected species – Leatherback turtles.....	64
5.2.2.3	Threatened/listed species – Loggerhead turtles.....	64
5.2.2.4	Threatened/listed species – Green turtles.....	65
5.2.2.5	Threatened/listed species – Flatback turtles	65
5.2.2.6	Threatened/listed species – Hawksbill turtles.....	65
5.3.1	Impacts from removal or damage to the environment	66
5.3.1.1	Prawns	66
5.3.1.2	By-product species.....	67
5.3.1.3	All retained and non-retained species.....	67
5.3.1.4	Impact to the mud/sand habitat	68
5.3.1.5	Impact to the coral/sponge habitat.....	71
5.3.1.6	Impact to the macro-algal habitats	71
5.3.2	Addition of materials to habitat.....	72
5.3.2.1	Discarding fish.....	72
5.3.3	General impacts on the environment.....	76
5.3.3.1	Creation of turbidity from trawling	76
5.3.3.2	Translocation	76
5.4	GOVERNANCE	77
5.4.1	Department of Fisheries – Management	77
5.4.1.1	Management effectiveness (outcomes)	77
5.4.1.2	Management arrangements	80
5.4.1.3	Compliance	83
5.4.1.4	Allocation among users.....	84
5.4.2	Department of Fisheries – Legal arrangements	84
5.4.2.1	OCS arrangements.....	84
5.4.3	Department of Fisheries – Consultation.....	85
5.4.3.1	Consultation	85
5.4.4	Department of Fisheries – Reporting.....	87
5.4.4.1	Assessments and reviews	87

6.0 Bibliography.....	89
7.0 Appendices.....	93
APPENDIX 1. Terminology	93
APPENDIX 2. Figures	94
APPENDIX 3. Attendees lists	95
APPENDIX 4. National ESD consequence levels and likelihood definitions for risk assessment	97
APPENDIX 5. Acronyms	100
APPENDIX 6. Research.....	101
APPENDIX 7. Stock monitoring surveys in Exmouth Gulf	104
APPENDIX 8. Materials supplied to Environment Australia against their specific guidelines.....	108
APPENDIX 9. Recommendations and approval from EA	127

List of figures

Figure 1.	Summary of process for completing ESD reports and their relationship with the Annual Report and State of Fisheries Reports	8
Figure 2.	EGP fishery locality map.	12
Figure 3.	Boundaries of the EGP fishery.	13
Figure 4.	EGP fishery annual landings and effort, 1963–2001.	14
Figure 5.	The standard twin otter rig and try gear used by prawn trawlers in Exmouth Gulf.	15
Figure 6.	Catch and effort history of king and tiger prawns in the EGP fishery.	18
Figure 7.	Catch and effort history of banana and endeavour prawns in the EGP fishery.	19
Figure 8.	Exmouth Gulf showing key tiger prawn spawning grounds, Q1 and Q2.	23
Figure 9.	Summary of the ESD reporting framework processes.	28
Figure 10.	Example of a component tree structure.	29
Figure 11.	Component tree for retained species.	36
Figure 12.	Exmouth Gulf fishing grounds showing key spawning areas Q1 and Q2.	38
Figure 13.	Exmouth Gulf spawning stock survey sites (shaded).	38
Figure 14.	Historical catch and nominal effort for tiger prawns in Exmouth Gulf.	39
Figure 15.	Historical catch of king prawns and nominal effort in EGP fishery.	43
Figure 16.	Historical catch of endeavour prawns and nominal effort in EGP fishery.	46
Figure 17.	Historical catches of banana prawns in the EGP fishery.	49
Figure 18.	Historical catch (tonne) of coral prawns and overall nominal total effort in the EGP fishery.	51
Figure 19.	Component tree for the non-retained species.	56
Figure 20.	Component tree for the general environment.	66
Figure 21.	Component tree for governance of the EGP fishery.	77

List of tables

Table 1.	Main National ESD reporting components.	27
Table 2.	Risk ranking definitions.	30
Table 3.	The National ESD report headings used in this report.	31
Table 4.	Exmouth Gulf tiger prawn spawning stock indices survey results.	41
Table 5.	The total catch of penaeids in the EGP fishery.	79
Table 6.	Comparison of terminology.	81

1.0 Introduction

Ecologically Sustainable Development (ESD) is the concept that seeks to integrate short and long-term economic, social and environmental effects in all decision-making. The Western Australian Government is committed to the concepts of ESD and these principles are implicitly contained in the objectives of the *Fisheries Resources Management Act 1994* (FRMA). More recently, the Minister for Fisheries released a “*Policy for the Implementation of Ecologically Sustainable Development for Fisheries and Aquaculture within Western Australia*” (Fletcher, 2002) to articulate, in a practical manner, how the Department of Fisheries can demonstrate to both the government and the broader community that these requirements are being achieved.

A major element of this policy was the requirement for reporting on the progress of each commercial fishery against the major ESD objectives by the end of 2003. This document forms part of this process being the ESD report for the *Exmouth Gulf Prawn Fishery*.

The reporting framework used to generate these ESD reports is the National ESD Framework for Fisheries (see Fletcher et al., 2002 or www.fisheries-esd.com for details). This framework operates by identifying the relevant issues for a fishery within 3 main categories of Ecological wellbeing, Human wellbeing and Ability to achieve completing a risk assessment on each of the identified issues and then providing suitably detailed reports on their status.

Due to recent changes in the Commonwealth environmental legislation administered by Department of Environment and Heritage¹, all export fisheries are now required to have an assessment on their environmental sustainability. As a consequence, the initial series of assessments for fisheries has concentrated on the environmental and governance components of ESD of this fishery. The social and economic elements of ESD will be covered in the next phase of assessments.

The reporting of performance for each fishery is the responsibility of the Department in conjunction with the relevant Management Advisory group and/or associated stakeholders. Consequently, the completion of this report has involved a substantial level of consultation and input from many groups including a public comment period. The list of participants involved in this development is located in Appendix 3.

This material has also been used as the basis to submit an application to Environment Australia to meet the requirements of the Commonwealths’ *Guidelines for the Ecologically Sustainable Management of Fisheries*. A copy of the application section of this submission, which was submitted in April 2002, is located in Appendix 1. The Exmouth Gulf Managed Prawn Fishery was awarded an exemption to Part 13A of the EPBC Act for the next five years. A copy of the recommendations imposed for this exemption are located in Appendix 7. Where relevant, these conditions have now been incorporated into the Performance Reports of the fishery (see Section 5).

These ESD reports provide a comprehensive overview of the information pertaining to each fishery. A major element of which is the explicit determination of the operational objectives, performance measures and indicators that will be used to assess performance of the fishery. Most importantly these reports include appropriately detailed justifications for the levels chosen and the methods used. Therefore, the annual *State of the Fisheries* reports on the evaluation of performance of this fishery against these sets of “agreed” objectives/performance measures (ie the full justifications will not be presented in the *SoF* reports). This is summarised in Figure 1.

¹ During the time this assessment was completed, this department was called Environment Australia (EA). Throughout this document, references to EA should be taken to mean DEH.

As stated in the Department's ESD policy, it is expected that the ESD report, and therefore the objectives and performance measures, will be reviewed every 5 years to ensure that they remain relevant and appropriate with current scientific protocols, social attitudes and prevailing environmental conditions. This will coincide with the next assessment cycle under the EPBC Act. The material presented here relates to the time of the application, not time of publication.

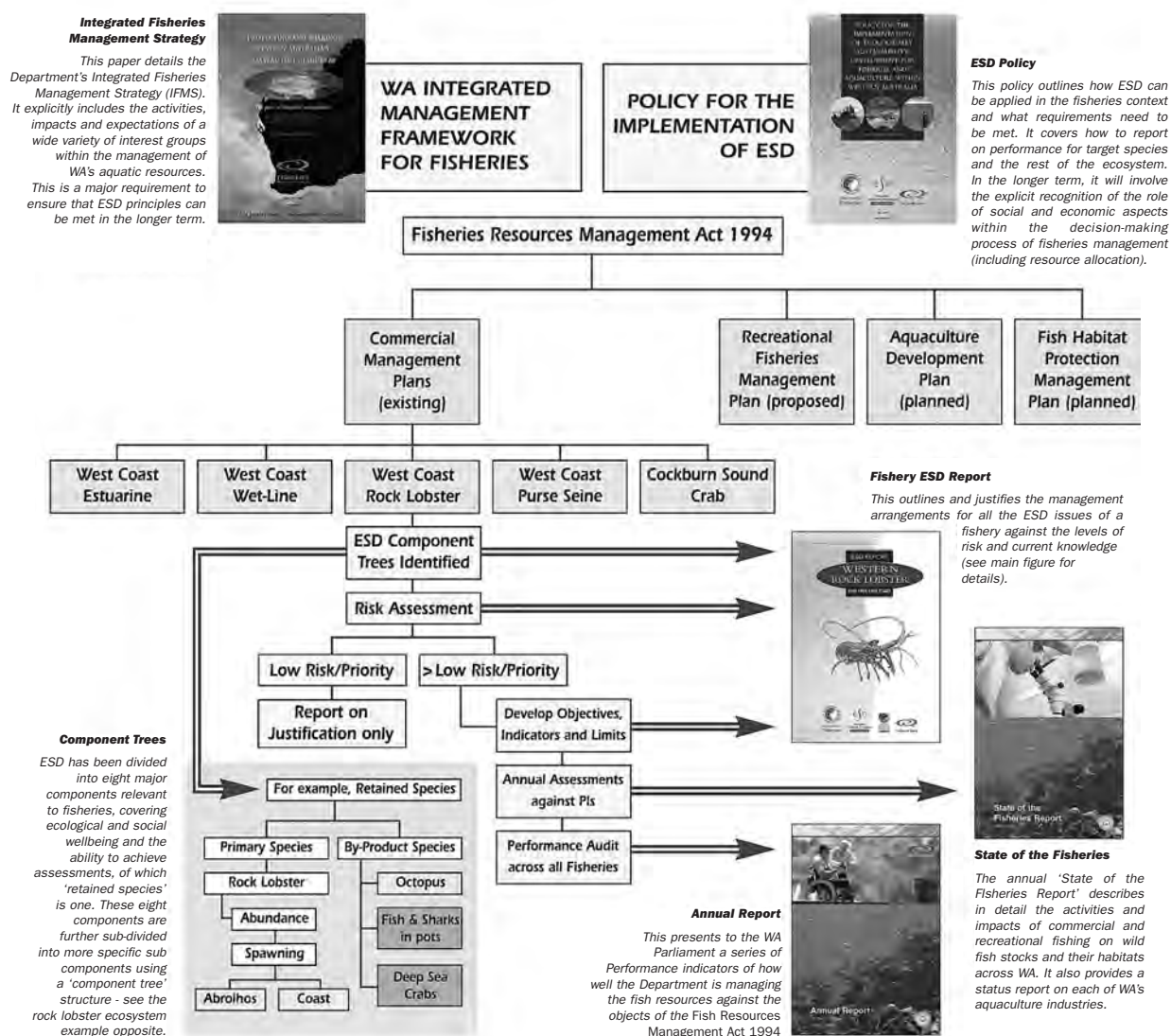


Figure 1. Summary of process for completing ESD reports and their relationship with the Annual Report and State of Fisheries Reports. (Example shown is for the West Coast Bioregion and the Western Rock Lobster fishery.)

2.0 Overview

The *Exmouth Gulf Prawn Fishery* (EGP) is one of the largest prawn trawl fisheries in WA and is located in the relatively sheltered waters in and to the north of Exmouth Gulf in the Gascoyne region. The EGP fishery began in 1963, initially targeting banana prawns. As the fishery expanded in the following years the initial target species changed with tiger and king prawns becoming increasingly more important. Currently, the two main target species of this fishery are the tiger prawn and western king prawn. King prawns contributing to around 505 tonnes of the total catch each year. This is the second largest prawn fishery in Western Australia (WA), with a landed value in 1999/2000 of around \$19 million.

The fishery has operated under a detailed and sophisticated management regime since the 1960s, with catches ranging from 771 to 1,456 tonnes per year over the past 10 years. The EGP Plan is the current management plan for the EGP fishery and is a formal statutory document, which dictates the management measures for the fishery. There is also an Exmouth Gulf Prawn Management Advisory Committee (EGPMAC), which helps to achieve cooperative management of this fishery through the provision of advice for achieving the maximum economic return, maintaining sustainability of the fishery and ensuring cost effective management.

The *Fish Resources Management Act, 1994* (FRMA) provides the legislative framework to implement the management arrangements for this fishery. The FRMA, and the specific management plan for the EGP fishery, adheres to arrangements established under relevant Australian laws with reference to international agreements as documented in (Section 5.4.2).

There is a sophisticated set of aerial based zoning, closed seasons, fixed and variable closed areas, along with a variety of biological controls along with VMS monitoring of the fleet. Each of these has been refined through time, and is subject to regular reviews to achieve the overall aim of successful management. In summary, these arrangements include:

- Small numbers of vessels and a limited entry fishery
- Fixed seasonal closures (November – April)
- Real time monitoring of fleet dynamics and operations by departmental staff
- Variable spawning/size season closures (areas closed or opened depending upon catch rates and sizes of prawns)
- Permanent area closures to preserve sensitive habitats that are essential nursery areas for prawns and other species
- Time closures- this now includes closures around the full moon
- Input controls on gear and vessel equipment (currently, the regulations allow the vessels in this fishery to tow two standard otter trawl nets and one otter trawl try-net but some operators have permits for the trial use of quad gear).

Significant effort is put into ensuring adequate compliance with these regulations. This includes at sea and aerial patrols to ensure closed seasons and closed areas, and operational rules are being adhered to. The use of VMS in 2002/03 on the vessels will help the Department of Fisheries monitor vessel location and speed, thus increasing compliance with closures while decreasing the need for untargeted patrol activities.

Research and monitoring of the EGP fishery has been conducted for about 40 years. Since the commencement of the fishery in 1963, catch and effort statistics has been collected for the EGP fishery. Additionally, voluntary log book information have been collected from fishers at the outset, providing a valuable long-term data set from which stock assessments can be made. Furthermore, this long-term data collection is valuable to the Department because it spans varying effort levels and environmental variations throughout the history of the EGP fishery.

The combination of having a large amount of relevant and accurate information on the biology and recruitment status of the prawn species, the sophisticated suite of management arrangements in place and the proactive management used in the EGP fishery have resulted in the maintenance of prawn stocks as well as the successful continuation of the fishery.

Assessments of current performance demonstrate that all of the target and byproduct prawn species are currently being maintained above levels necessary to maintain ecologically viable stock levels. Thus, in summary:

- The breeding stock level for the tiger prawn stock in Exmouth Gulf is currently above the agreed reference point.
- The historical catch and effort trends over the past 40 years indicate that there has been no decline in the production levels for king prawn in Exmouth Gulf, which is consistent with there being sufficient on-going levels of spawning biomass for this species.
- Historical catch trends indicate that the production levels for endeavour and banana prawns remain within natural environmental levels, which is consistent with the recruitment potential of these species having not been affected by the fishery.
- The level of capture of other by-product species by this fishery is too small to have a significant impact on their dynamics.

The fishery has also taken a positive response to minimise wider ecosystem interactions. Trawling is restricted to a relatively small area of the Exmouth Gulf region, which mainly occurs over sandy/muddy substrates. Bycatch reduction devices and turtle excluding devices are currently being phased-in, which will minimise or, in some cases eliminate, the potential for impacts on other species. Therefore, of the fifteen non-retained species identified in this fishery, all of them were ranked as either negligible or low risks. Furthermore, six of these fifteen issues relate to species not actually being captured in the net, but only affected by general fishing operations.

In the capture category for non-retained species, the assessment concluded that the EGP fishery was only a negligible risk to seasnakes, syngnathids, green turtles, flatback turtles, loggerhead turtles, hawksbill turtles and leatherback turtles. For the direct interaction but no capture category for non-retained species, this assessment concluded that the fishery was of negligible risk to all of the turtle species (loggerhead, green, flatback, leatherback, hawksbill) and cetaceans & dugongs.

Of the nine general ecosystem issues identified for the EGP fishery, some (impacts on benthos and discarding of bycatch) were rated as a low risk. The others (trophic impacts from removal of - prawns, by-products, bycatch and all removals; turbidity and translocation) were rated as a negligible risk.

The impact on the environment, by removing the retained and discarded species was considered to be only a minor risk on the Exmouth Gulf environment because the spatial and temporal closures ensure that adequate stocks of all species survive. Moreover, the total removal of biological material by the EGP fishery is not likely to be detectable because Exmouth Gulf is a highly productive region.

The potential impact on the mud and sand habitat on Exmouth Gulf, as a result of the prawn trawling operations, was considered unlikely to have even a minor consequence on these habitats because:

- Of the area permitted to be trawled, only 35% is actually trawled (due to targeting of known favourable grounds).
- Furthermore, 28% of the area is permanently closed to trawling.
- Studies of actual impacts from prawn trawling suggest only minimal impacts to infaunal communities on mud/sandy bottoms.

The impact of the provisioning from the discarding of bycatch by the EGP fishery was considered 'possible' to be a 'minor' consequence because the area over which bycatch are discarded is large and therefore any impacts would be diffused. Moreover, the introduction of BRDs will reduce the amount of bycatch generated by this fishery, which in turn reduces the amount of discards.

Consequently, the management regime for the EGP has met the *Guidelines for the Ecologically Sustainable Management of Fisheries* and was formally approved by the Federal Minister for the Environment on March 12, 2003.

3.0 Background on the Exmouth Gulf Prawn Fishery

3.1 DESCRIPTION OF THE FISHERY

The EGP fishery is one of the largest prawn trawl fisheries in WA and is located in the relatively sheltered waters in and to the north of Exmouth Gulf (see Figure 2). As defined in the Exmouth Gulf Prawn Management Plan 1989 (the EGP Plan), the EGP fishery exists within:

“the waters of the Indian Ocean and Exmouth Gulf below high water mark lying south of a line starting at Point Murat and extending northeasterly to the southern extremity of South Muiron island; thence generally northeasterly along the southeastern shore of that Island to its easternmost extremity; thence northeasterly to the southern extremity of North Muiron island; thence northeasterly and northerly along the south eastern and eastern shores of that Island to its northern extremity; thence easterly to the northern extremity of Serrurier Island (also known as Long Island); thence generally southerly along the western shores of that Island to its southern extremity; thence southeasterly to the southern extremity of Locker Island and then due south to the mainland” (Figure 3).

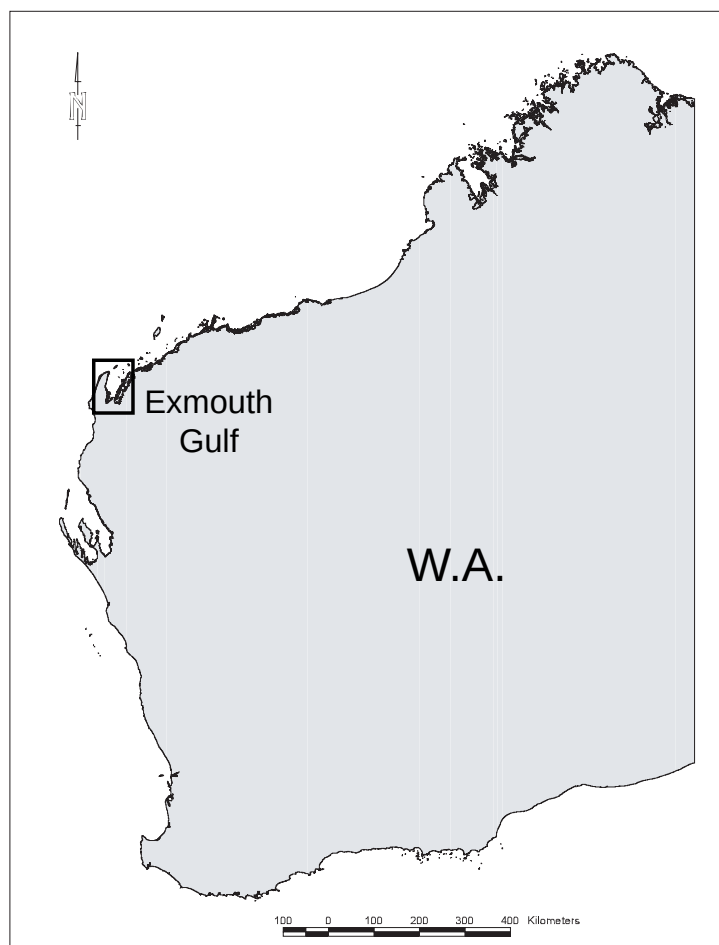


Figure 2. EGP fishery locality map.

The Fishery is further divided up into four distinct fishing areas, Areas A, B, C and D and a permanently closed nursery area, which are denoted in Figure 3.

The EGP fishery began in 1963 initially targeting banana prawns with a catch of 68 tonnes (banana 52 tonnes, king 1 tonne and tiger 15 tonnes). As the fishery expanded in the following years the initial target species changed as tiger prawns became increasingly more important. Now, the two main target species of this fishery are the tiger prawn and western king prawn, with king prawns contributing to around 505 tonnes of the total catch each year. The catch in 1999 was 1,467 t (king prawns 471 t, tiger prawns 451 t, endeavour prawns 543 t, banana prawns 2 t) and valued at \$19.4 million (Figure 4). As a result, the EGP fishery is the second largest prawn fishery in WA (Sporer and Kangas, 2001).

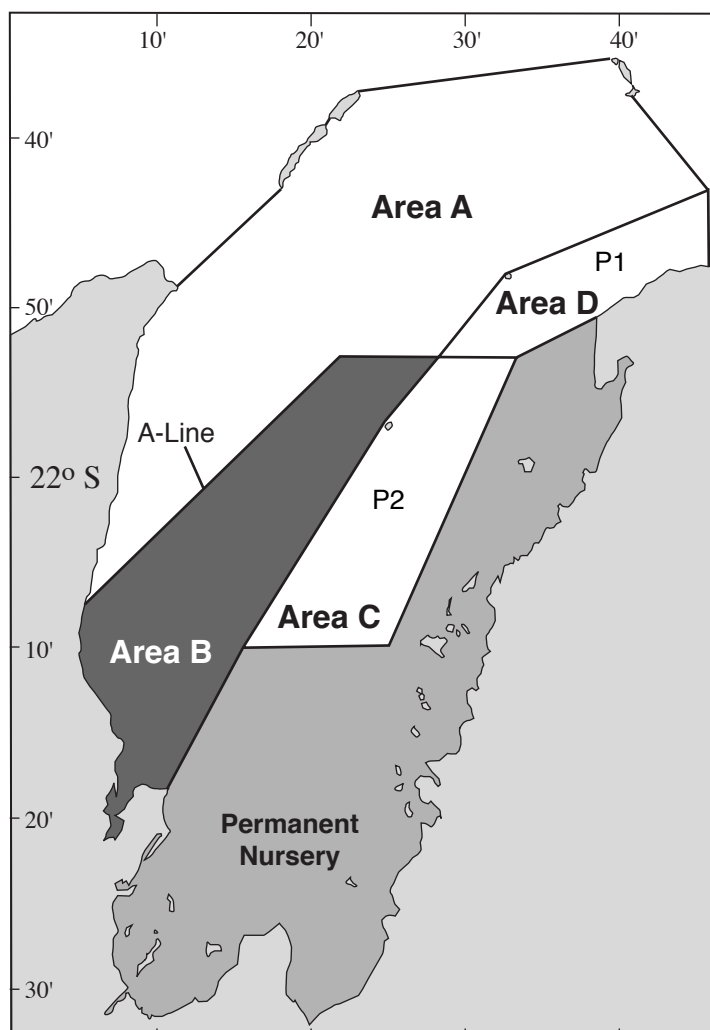


Figure 3. Boundaries of the EGP fishery.

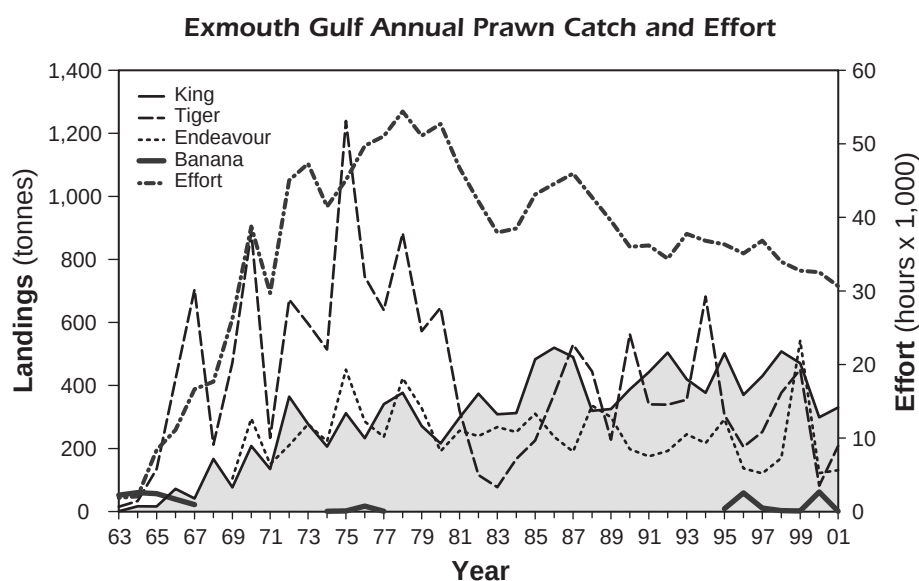


Figure 4. EGP fishery annual landings and effort, 1963–2001.

Fishing methods (see Appendix 1 for terminology)

The main method of fishing used in the EGP fishery is demersal otter trawling (Figure 5). Currently, the regulations allow the vessels in this fishery to tow two standard otter trawl nets, each with a headrope length of greater than five (5) metres, but not exceeding 13.72 metres, and one otter trawl try-net with a headrope not exceeding five (5) metres in length (but see below for new initiative in the use of quad gear). Each tow is approximately 60 to 200 minutes in duration. Unless otherwise approved, otter boards should not exceed 2.29 metres in length and 0.91 metres in breadth. The otter board shoes should not exceed 150 millimetres in width and 25 millimetres in depth. The otter boards are attached to the extremities of each net at the opening (Figure 5). The height of the fishing gear is set by the height at the point where they are connected to the otter boards. Forces produced by water flowing over the otter boards open the trawl nets laterally. The lateral spread is vital to the catching efficiency of trawl gear and determines the area swept. Generally, the headrope and ground rope is spread between 60% and 85% of their length. Attached to the footrope is the ground chain, which is limited to 10 mm diameter. The ground chain travels the sea floor and disturbs prawns and scallops so they rise from the seafloor and into the oncoming net. Low opening nets have the headrope as a lead-ahead, which acts as a net veranda and is set in front of the footrope. This ensures that prawns disturbed by the ground chain do not pass over the headrope and thus maintains the catch efficiency of the nets.

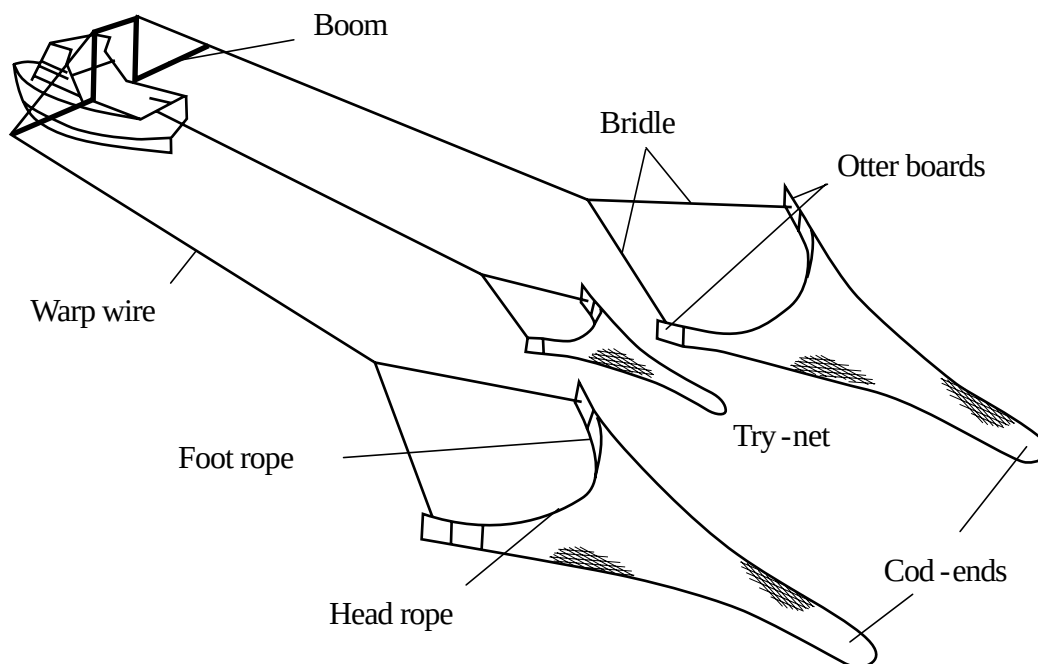


Figure 5. The standard twin otter rig and try gear used by prawn trawlers in Exmouth Gulf.

Over the past three seasons the operators in the Fishery have been granted an exemption by the Executive Director, which permits the trial use of quad gear (as opposed to the twin gear described above). These trials encourage an increase in fleet efficiency within the framework of sustainable fisheries management. Even if there is a small increase in the relative fishing power of the quad gear over the standard twin gear, any impact of this increase will be offset by the reduction in vessels actually fishing. Furthermore, the total headrope allocation of 240 fathoms (approximately 439 metres) for the fleet has been reduced to 234 fathoms (approximately 428 metres) as a result of the headrope redistribution. It is intended, depending on the results of the 2001 trial, that the Plan be formally amended to allow for the use of quad gear within the EGP fishery on a permanent basis.

In addition, the fleet is currently using bycatch reduction devices (BRDs) in the form of large object excluders (that is, grids) and finfish excluders (such as, square mesh panels). The grids have been bottom-opening varieties (as opposed to the top opening types used in Shark Bay) given the occurrence of heavy rocks and sponges on the trawl grounds. However, top opening grids were used in 2002. BRDs were made mandatory throughout the fleet in 2002/03. Furthermore, approximately five vessels in the Fishery have a 'well' sorting system on board. This system allows for the catch to remain in water for an extended period thereby maximising the survival of discarded species. These systems are relatively expensive so it is not expected that the entire fleet will be refitted in the near future.

Management

The EGP Plan is the current management plan for the EGP fishery and is a formal statutory document that dictates the management measures for the fishery. The Exmouth Gulf Prawn Management Advisory Committee (EGPMAC) achieves cooperative management of this fishery through the provision of advice. The advice provided allows for the management to be better tailored for achieving the maximum economic return from the prawn resource as well as maintaining sustainability of the fishery and ensuring cost effective management.

Management of the EGP fishery is an “input controlled fishery” that has a complex series of management restrictions, including limited entry, boat size and gear controls and seasonal spatial and temporal closures. These management restrictions (in particular the spatial and temporal closures) help to sustain all of the prawn species while maintaining the supporting environment and maximising the size of the prawns at capture. In reality, the fishery is managed under a “constant escapement policy”, which is designed to leave a minimum level of tiger prawn spawning stock during their breeding season to maximise recruitment levels the following year.

A summary of these input based controls outlined in the Plan for this fishery is as follows:

Small numbers of vessels and limited entry fishery. There are a limited number of vessels operating in the Fishery. The numbers of vessels have been reduced over time and may continue to be reduced, as effective fishing effort increases with technology. Currently, there are sixteen Managed Fishery Licences (MFLs) within the Fishery. Fifteen of these are owned by one operator. However, as a result of current changes in gear configuration (redistribution of the total headrope length to four 4.5 fathom nets each) only thirteen vessels operated within the Fishery during the 2001 season.

Seasonal closure. The Fishery is generally closed between November and April, to allow prawn stocks to rejuvenate.

Area closures. Parts of Exmouth Gulf are permanently closed to trawling (Figure 3), to preserve seagrass and other sensitive habitats that are essential nursery areas for prawns and other species. There is also a complex series of Fishery openings and closures as a result of the compartmentalization of the fishing grounds, designed to allow fishing of the prawns as they reach optimal marketable size. These temporal closures occur in Areas B, C and D of the Fishery (Figure 3). The actual area trawled is approximately 35% of the licensed area.

Time closures. King and tiger prawns are predominantly nocturnal and therefore trawling is generally only permitted between 1700 hrs and 0800 hrs. Trawling for prawns during the day (except for banana prawns for which specific permission may be granted) is often unproductive as prawns burrow in the sediment. There are also several complete 24-hour closures throughout the season over each period of the full moon, to increase economic efficiency by protecting moulting soft-shelled prawns.

Gear controls. As previously described, there is a series of gear controls that include restrictions on the mesh size and the number of nets, the length of trawl net headrope, and the size of the trawl otter boards and ground chains. The operators in the EGP fishery are currently using quad gear under the provision of an Exemption from the Executive Director.

Additionally, in 2002 the Vessel Monitoring System (VMS) was introduced into the Fishery. The VMS enables the Department of Fisheries to monitor a vessel’s location and speed with particular attention paid to the surveillance of nursery areas.

Target species

Western king prawns are now the dominant species caught by this fishery. Tiger prawns and a smaller portion of endeavour and coral prawns make up the remainder of the catch. Banana prawns are taken sporadically in this fishery. Prawns and retained by-product species are generally chilled rather than frozen due to the close proximity of the fishing grounds to port. This also enables prawns to be landed fresh and graded prior to freezing – thereby maximising economic return.

Although this fishery began targeting banana prawns in 1963, by 1966 night trawling, which targeted tiger prawns, had become the major fishing activity in Exmouth Gulf. In 1975, catches of tiger prawns had reached 1,239 tonnes. Until 1980, tiger prawns were the dominant catch and during these years the effort in the Fishery increased (Penn et al., 1997). In 1981 and 1982, there was a decline in recruitment and subsequent catch of tiger prawns because of overfishing of this tiger prawn stock. This resulted in a catch of only 77 tonnes in 1983 (Figure 6). Tight management restrictions were introduced at this time in order to rebuild the tiger prawn stocks. Variable closures of the main tiger prawn fishing grounds and extension of permanent closure areas to allow a constant escapement of tiger prawns sufficient enough to provide an optimal level (threshold catch rate) of spawning stock irrespective of annual recruit strength were introduced into the Fishery to reduce effort levels (Penn et al., 1997). Since 1984, industry funded buy-back schemes have operated in the Fishery, resulting in the removal of 7 licences.

Since the introduction of the additional management measures, tiger prawn stocks continue to show improvement as their breeding stocks increase. This improvement is reflected in the tiger prawn catches, which have returned to levels achieved in the 1970s (400 – 600 tonnes). Management strategies are continually being reviewed to ensure adequate spawning stock levels (for normal environmental conditions) remain. By using historical catch and effort data, it was evident that a strong spawning stock - recruitment relationship existed for the tiger prawn. As seen in the past, changes in the efficiency of the fishing fleet and effort must be monitored carefully, to ensure that tiger prawn spawning stocks are not over-exploited.

For king prawns, catches have increased from the early 1980s due to increased targeting of effort on king prawns. At current effort levels, there is no evidence of an adverse impact on production of this stock. The annual production of king prawns generally reflects the overall effort in the fishery, as well as the level of targeting of king prawn areas by the fleet. The level of targeting has generally been a function of the annual abundance of king prawns relative to the tiger prawn stocks that occur in the more protected southern sector of the Gulf.

Due to the behaviour (nocturnal and strong lunar relationship) and high reproductive output of king prawns they appear to be less susceptible to recruitment overfishing in Exmouth Gulf. This has been demonstrated by the increased effort on king prawns since the 1980s with no evidence of lower production under normal environmental conditions.

Current stock and recruitment studies indicate that the king prawn stock remains at a point where recruitment is not affected by the residual stock biomass. Various management practices have been employed to increase the survival of these spawning stocks and it is likely that at the current level of exploitation, fluctuations in the annual king prawn harvest are a result of effort level and environmental variation.

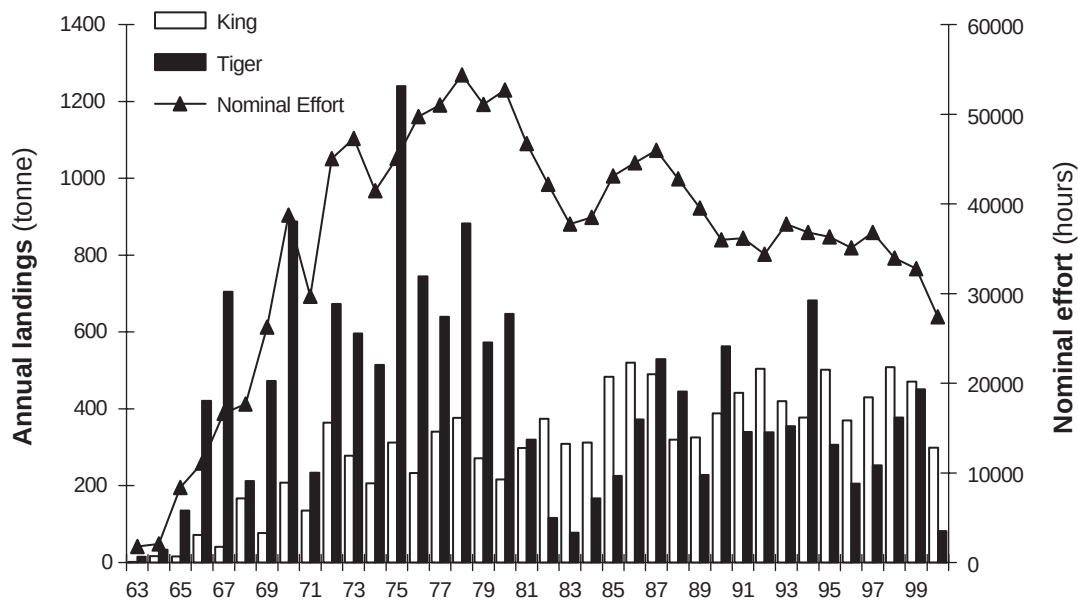


Figure 6. Catch and effort history of king and tiger prawns in the EGP fishery.

Even with the effective effort in the Fishery directed more on king and tiger prawns, endeavour and banana prawns are also caught, but in relatively small numbers. Effort is generally not targeted towards the capture of the endeavour prawns because they are a lower-value species. It is likely that in some years, area closures aimed at either tiger or king prawns may preclude the take of endeavour prawns as they are generally found inshore from the tiger and king prawn trawl grounds. The endeavour prawn stock are, therefore, less likely to be affected by fishing than the tiger prawn stock.

Since the banana prawn stocks were the first to be exploited in Exmouth Gulf, the catch declined quite rapidly (Figure 7). Banana prawns typically aggregate and in some instances may be so dense as to produce surface ‘boils’. This behaviour makes them highly vulnerable to exploitation and as a result it appears that fishing pressure contributes to keeping the banana prawn stocks relatively low on the trawl grounds. In addition, the catch of this species is positively correlated with local rainfall levels from December to March. In 1997, the banana prawn catch peaked at 59 tonnes and a number of operators traded night trawls for day trawls to specifically target the large number of banana prawns that are sometimes found in Exmouth Gulf (Figure 7). However, the fishery has not reduced the banana prawns overall potential because their numbers return whenever a run of suitable environmental conditions occurs.

In addition to prawns, the trawl nets collect a number of other species that are retained by the vessels. Some of the by-product species include squid, cuttlefish, tuna, crabs, shark and finfish (see Appendix A2.1)

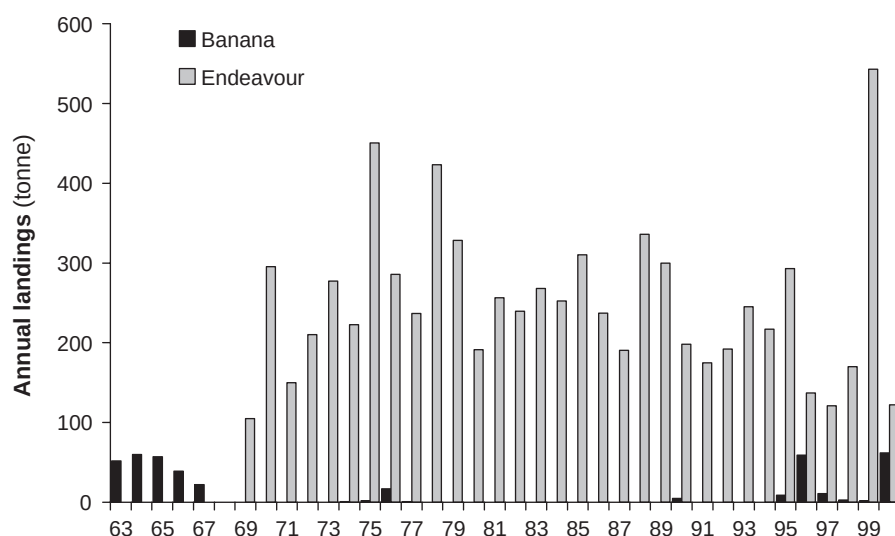


Figure 7. Catch and effort history of banana and endeavour prawns in the EGP fishery.

Annual variation in the catches of all species is evident, which is most likely due to weather and especially cyclone events, which provide either a positive or negative effect depending upon the species. Thus, in 2000, the lower than average season in Exmouth Gulf prawn fishery, particularly for tiger prawns can be attributed to several factors (Figure 6). During 1998 and 1999 the tiger prawn spawning stock within Exmouth Gulf was maintained at an acceptable level. The 1999 season provided high total landings of tiger prawns with the highest spawning index recorded so far during the 1990s. On 22 March 1999, cyclone Vance crossed Exmouth Gulf, resulting in gale force winds and heavy rainfall. This increased the migration of tiger and endeavour prawns into the trawl grounds and increased the level of suspended sediments in the Gulf creating high turbidity for several months after the cyclone. The short-term effects of the cyclone appeared to be higher catch rates for all species, particularly endeavour prawns (Figure 7). Therefore, higher total landings were observed for the 1999 season. In 2000, the catch of banana prawns was up significantly due to high rainfall (Figure 7).

Inshore areas (nursery habitats) of Exmouth Gulf were adversely affected by the cyclone and a survey, fortuitously carried out by Commonwealth Scientific and Industrial Research Organisation (CSIRO) in November/December 1999 was unable to find significant quantities of juvenile tiger prawns. This was reinforced by the three recruitment surveys undertaken by the Department of Fisheries – Research in March to April 2000, which indicated low recruitment indices in the area considered to contribute to around 70% of the catch for the season. A high proportion of the prawns caught during these surveys were larger prawns, not recent recruits. This low tiger prawn survival to the fishery had a negative impact on the 2000 season.

The very low tiger prawn catch was also due in part to the management controls, which ensured that sufficient tiger prawns were left to become the spawning stock for 2001. Secondly, the need to close the tiger prawn grounds early (to protect the breeding stock) significantly reduced access to the endeavour prawn stock and catches (Figure 7).

During the history of this fishery, low catch years have been followed by several years of rebuilding (providing environmental conditions are not detrimental) the stock to average and above average levels.

Additionally, given that this fishery is multi-species, with the primary target species (western kings and tigers) and secondary species (banana and endeavour) having overlapping habitats but different capture rates and spawning strategies, management must ensure that fishing for one species does not jeopardise the sustainability of the other. Thus the management arrangements try to optimise not maximise the catch.

Non-Retained Species

While target stocks are relatively well maintained in this fishery, public concern in recent years has increased regarding general bycatch resulting from fishing activities, particularly trawling. As a result of the limited information on the bycatch generated by this fishery, a two-year research program on the implementation of BRDs began in 2000. This program included an observer program designed to record, identify and quantify bycatch in the EGP fishery.

A draft Bycatch Action Plan (based upon the detailed information presented later in this report) has been prepared for this fishery based on consultation with the conservation, recreational fishing and commercial fishing sectors.

Research

Research and monitoring of the Fishery has been conducted for about 40 years. Since the commencement of the fishery in 1963, catch and effort statistics have been collected for the EGP fishery. Additionally, voluntary log book information has been collected from fishers at the outset, providing a valuable long-term data set from which stock assessments can be made (Figures 6 & 7). Furthermore, this long-term data collection is valuable to the Department because it spans varying effort levels and environmental variations throughout the history of the EGP fishery.

Research activities will continue to focus on stock assessment and monitoring the status of prawn stocks, particularly tiger prawns. As with all skippers of WA fishing boats, there is a statutory licence requirement to submit monthly returns indicating the level of catch and effort. In Exmouth Gulf, trawler skippers also voluntarily (with 100 percent participation) complete daily log sheets.

Fishery-independent data is also collected to gauge the level of recruitment during March and April each year and to determine the level of spawning stock during August, September and October each year. Two commercial boats participate in each of these surveys.

There is very limited existing information on the level and nature of bycatch in the EGP fishery, and about the bycatch at the commencement and other stages over the history of the Fishery. The extent of information thus far is contained in the CAESS (Catch and Effort Statistics System) Data Information on declared non-target catch in the Fishery (commonly known as Monthly Returns) and limited field observations. Data obtained from the CAESS or the Fishery from 1980 to 2000 showed that the dominant by-products, in terms of weight and value are coral prawns, squid and blue swimmer crabs.

A current Fisheries Research and Development Corporation (FRDC) (2000/175) funded program on the implementation of bycatch reduction devices is collecting additional information on bycatch and by-product species in the Fishery. This program commenced in 2000 and is due to be completed by 2002 (see Appendix 7 for details of the observer program). Another project funded by FRDC (2000/132), looking at the inshore fish assemblages of the Pilbara and Kimberley coasts, is also quantifying inshore and trawl caught fish species in Exmouth Gulf. A collaborative project with industry to review the impact of trawling on non-target species has been evaluating gear modifications to reduce bycatch and improve product quality.

Appendix 6 provides an outline of the past, present and future research project for the EGP fishery.

3.2 BIOLOGY OF WESTERN KING PRAWNS

Distribution and stock structure

The western king prawn, *Penaeus latisulcatus*, is a decapod crustacean of the family Penaeidae. *P. latisulcatus* has been reported from the Indo-West Pacific region, the Red Sea, and Arabian Gulf in the west, through Malaysia, Korea and Japan to the north and through Indonesia to New Guinea and Australia to the south (Grey et al., 1983). Within Australian waters *P. latisulcatus* has been reported from South Australia (SA), Western Australia, Northern Territory, Queensland and down the east coast to northern New South Wales (Grey et al., 1983). Electrophoretic studies found genetic differences among the populations sampled from WA, the Gulf of Carpentaria and SA (Richardson, 1982). Furthermore, this species generally only forms high level stocks in areas associated with the hypersaline waters of marine embayments (Kailola et al., 1993), which are likely to be largely independent of each other in terms of dynamics. This species is the dominant penaeid prawn species in the WA and SA fisheries, representing about 65% and 100% of their total catches respectively.

Juveniles are found inshore where they remain in shallow water nursery grounds for 3 to 6 months and as adults move offshore to spawn. In general, the species is found in coastal waters down to a maximum of about 80m and commonly found by trawlers over hard sediment substrates i.e. sand, sandy mud or gravel. In Exmouth Gulf, the king prawn stock is most abundant in the northernmost oceanic sector of the Gulf (Figure 3) (Penn et al., 1997).

Life history

The species can live for up to 4 years, although animals greater than 2 years are rarely caught under current harvesting practices. King prawns become mature at 6 to 7 months of age at around a size of 25 mm carapace length.

When prawns mate, the male needs to be hard shelled and the female needs to be soft shelled (newly moulted). The male inserts a sperm capsule (spermatophore) into the female. This spermatophore remains inside the female reproductive organ (thelycum) until the female is ready to spawn. The female's ovary develops rapidly and the eggs are released into the water before the female moults again, normally within a period of about one month (Penn and Stalker, 1979). At spawning, the eggs are released from small pores at the base of the third walking legs (Walker, 1975). Western king prawns have the ability to spawn numerous times throughout the year, producing approximately 100,000 to 700,000 eggs per spawning.

The larval development of *P. latisulcatus* has been described by Shokita (1984). During spawning the females swim near the bottom releasing the eggs, which float and usually hatch within 24 hours. After hatching from the egg the larvae called nauplii swim freely in the water column but do not feed. During the nauplii stages the larvae utilise stored food from the egg, completing a series of six moults before developing to the next larval stage (Penn and Stalker, 1979). The larval development continues through several stages: protozoa, mysis and postlarvae. This process generally takes from one to three weeks before the larvae are at the stage where they can settle onto the sea floor. During this period, predators are responsible for the high mortality rates of the larvae. If by this time the larvae have drifted to a suitable nursery area (i.e. shallow sand/mud flats) they will settle (at around 10 mm total length) and continue to grow into juveniles. If settlement occurs into unsuitable habitats they are likely to perish (Penn and Stalker, 1979).

Juvenile western king prawns bury into the substrate (generally shallow sandy banks) during the day. Whilst in the nursery grounds western king prawns are nocturnal and forage at night feeding on small animals and detritus. Juveniles spend around three to six months in nursery grounds, which allows them to physically mature to between 107 and 127 mm total length (Penn and Stalker, 1979). At this point they attain a size, which relates with them migrating offshore to oceanic waters and subsequently, entering the trawl fishing grounds. This migration takes place in the summer and autumn of each year and is termed recruitment to the fishery.

The king prawn feeds primarily on meiofauna and decayed organic matter (detritus) and are prey to a large variety of fishes and molluscs, e.g. squid and cuttlefish.

3.3 BIOLOGY OF BROWN TIGER PRAWNS

Distribution and stock structure

The brown tiger prawn, *Penaeus esculentus*, is a decapod crustacean of the family Penaeidae. *P. esculentus* is generally regarded as an endemic Australian species. It has a distribution around the top half of Australia and whilst the electrophoretic study on this species (Mulley and Latter, 1981) found no genetic differences amongst regions, there are a large number of functionally independent stocks. Each of these stocks is associated with relatively sheltered waters where there are also substantial amounts of seagrass, which forms the main juvenile habitat for this species (and explains their distinctive coloration).

Given this patchy distribution, there are a number of commercially abundant stocks of *P. esculentus* in Western Australia (Shark Bay, Exmouth Gulf, Onslow, Nickol Bay), Northern Territory (the Gulf of Carpentaria, Darwin, Torres Strait), Queensland (Moreton Bay, Yeppoon, Mackay, Bowen and Weipa) (see Kailola et al., 1993 for map).

This species is generally found in coastal waters down to approximately 60m but has been recorded to a depth of 200m (Grey et al., 1983) and is commonly found over mud or sandy mud substrates by trawlers (Hall and Penn, 1979). Most spawning females are found in 13 to 20m of water (Penn and Caputi, 1985). In Exmouth Gulf, the tiger prawn stock is most abundant in the southern portions of the gulf, which is nearing the southern extremity of its distribution, as it is predominantly a tropical species restricted to northern Australia.

Life history

This species can live for over 2 years although animals over 2 years are rarely caught under current harvesting practices. Tiger prawns become mature at 6 to 7 months of age at a size around 25 – 28 mm carapace length.

The *P. esculentus* stock in Exmouth Gulf follows the general penaeid life cycle described by Garcia and Le Reste (1981), with the important exception that the juvenile phase occurs in the hypersaline, marine littoral zone along the eastern shoreline of the Gulf, rather than in a typical estuarine or lagoon habitat (White, 1975a). The spawning cycles of the *P. esculentus* stock in Exmouth Gulf have been reported in White (1975a) Penn and Caputi (1985, 1986) and Penn et al. (1995). In Exmouth Gulf, spawning takes place from August through to March. Towards the end of the winter (July-August), recruiting female *P. esculentus* from the previous spring (now 10 to 12 months old) are sexually mature and aggregate in the 13 to 20m depth zone in the centre of the Gulf [spawning area Q1 (Figure 8)]. Spawning commences around this time for the majority of this cohort, peaking in the late winter-spring period (August-

October). Mature females then continue to spawn through the summer months, with each successive moult (Penn and Caputi, 1985). Although unconfirmed, a second smaller peak in spawning is believed to occur around autumn (March-April), coinciding with the peak recruitment period from the previous spawning in spring (Dr. J. Penn*, pers. comm.).

As for western king prawns, when tiger prawns mate, the male needs to be hard shelled and the female needs to be soft shelled (newly moulted). The male inserts a sperm capsule (spermatophore) into the female. This spermatophore remains inside the female reproductive organ (thelycum) until the female is ready to spawn her eggs. The female's ovary develops rapidly and the eggs are released into the water before the female moults again. The moulting cycle of the adult *P. esculentus* in Queensland is around 27 days (Crococ and Kerr, 1983). During spawning, which usually occurs at night the eggs are released from small pores at the base of the third walking legs (Walker, 1975). Tiger prawns produce approximately 50,000 to 400,000 eggs per spawning. The numbers of eggs being released reaches a small peak during autumn and a larger peak in spring with lower levels of spawning activity (compared to western king prawns) occurring throughout the year (Penn and Stalker, 1979).

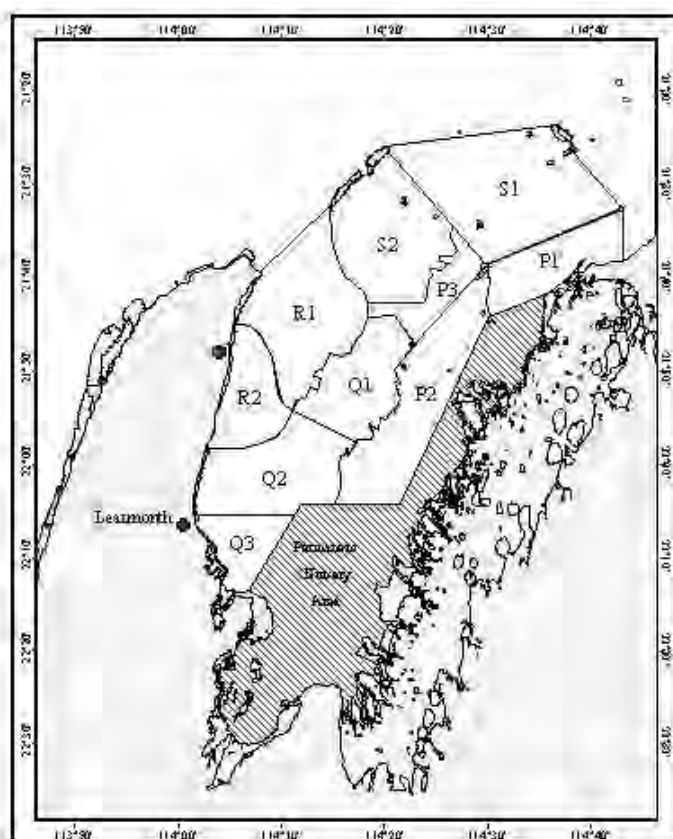


Figure 8. Exmouth Gulf showing key tiger prawn spawning grounds, Q1 and Q2.

* Dr. J. Penn, Department of Fisheries.

The stages of larval development for the tiger prawns is similar to that of king prawns. At spawning the females swim near the bottom releasing the eggs, which float and usually hatch within 24 hours. After hatching from the egg the larvae called nauplii swim freely in the water column but do not feed. During the nauplii stages the larvae utilise stored food from the egg, completing a series of six moults before developing into the next larval stage (Penn and Stalker, 1979). The larval development continues through several stages: protozoa, mysis and postlarvae. This process generally takes from one to three weeks before the larvae are at the stage where they can settle onto the sea floor. During this period, predators are responsible for high mortality of the larvae. If by this time the larvae have drifted to a suitable nursery area (i.e. inshore structured habitats, which fringe sand flats) they will settle (at around 10 mm total length) and continue to grow into juveniles. If settlement occurs into unsuitable habitats they are likely to perish (Penn and Stalker, 1979). In general juvenile *P. esculentus* prefers to inhabit structured habitats such as algae or seagrasses. However, in Exmouth Gulf the amount of seagrass beds and algae is relatively low compared to other parts of Australia where juvenile tiger prawns occur.

Juveniles spend around three to six months in nursery grounds, which allows them to physically mature to between 101 and 121 mm total length (Penn and Stalker, 1979). At which point, they attain a size that coincides with them migrating offshore and subsequently, entering the trawl fishing grounds. This usually takes place in the summer and autumn of each year and is termed recruitment to the fishery (Penn and Stalker, 1979). In Exmouth Gulf, primary recruitment occurs along the southeastern and eastern sections of the Gulf (Harris, 2000).

The tiger prawn feeds at night, primarily on meiofauna including molluscs, crustaceans and polychaete worms (Wassenberg and Hill, 1987). They are prey to squid, cuttlefish and a variety of demersal fishes. The juveniles are particularly vulnerable to predation by fish species including barramundi, threadfin salmon, cod and small sharks.

3.4 BIOLOGY OF ENDEAVOUR PRAWNS

Distribution and stock structure

The endeavour prawn, *Metapenaeus endeavouri*, is a decapod crustacean of the family Penaeidae. *Metapenaeus endeavouri* is restricted to northern Australian waters between northern New South Wales and Shark Bay in Western Australia (Grey et al., 1983). Population studies on endeavour prawns from Exmouth Gulf and the Gulf of Carpentaria indicate a high degree of genetic isolation between them. The endeavour prawn stock tends to overlap the distribution of the tiger prawn in the northern sector of the Gulf and also to some extent the king prawn distribution in the north.

This species is generally found in coastal waters down to approximately 50m and is commonly trawled over in muddy or sand/mud sediment substrates. They are generally found inshore of the main fishing grounds for the tiger and king prawns.

Life history

Endeavour prawns spawn year round and in Queensland spawning peaks in March and September (Courtney et al., 1989). There is little information on larval development in blue endeavour prawns (Kailola et al., 1993). Juvenile endeavour prawns are most commonly associated with seagrass beds in shallow estuaries although they are occasionally found in other areas (Staples et al., 1985). They spend a short period of time in nursery areas and migration to adult habitats occurs at a small size (Buckworth, 1992). In the Torres Strait, recruitment is mainly in the summer months (Somers et al., 1987).

Endeavour prawns are carnivorous benthic feeders. Squid, cuttlefish and a host of demersal finfish species commonly prey upon endeavour prawns.

3.5 BIOLOGY OF BANANA PRAWNS

Distribution

The banana prawn, *Penaeus merguensis*, is a decapod crustacean of the family Penaeidae. In Australia, banana prawns are present from Shark Bay in WA north through a northern Australian range to the Tweed River in northern New South Wales. The banana prawn stock found in Exmouth Gulf is at the southern limit of the species range.

This species prefers shallow estuarine and intertidal areas to depths of 45 metres. They live in turbid waters most of their lives, inhabiting sheltered mangrove creeks as juveniles and medium and low-energy coastlines as adults.

Life history

Banana prawns sexually mature at around 7 to 8 months of age and will spawn continually until they are caught or die. The maximum life span for banana prawns is around 12 to 18 months. However, there are generally spawning ‘peaks’ during both spring and autumn. The larval stage is about 2 to 3 weeks long (temperature dependent) and then the post-larvae will move in and settle into shallow nursery areas. The post-larvae will spend around 2 to 4 months in nursery areas before they start to move offshore, this movement can take up to 2 months to complete. Therefore, banana prawns are around 5 to 8 months old when they move into fishing grounds. Banana prawns typically aggregate and in some instances may be so dense as to produce surface ‘boils’. This aggregating behaviour makes them highly vulnerable to exploitation. The catch of this species is positively correlated with local rainfall levels from December to March.

Banana prawns are bottom feeders, mostly polychaete worms and bivalves. Predation by sharks and finfish appears to be very high, accounting for a large part of their natural mortality (Staples et al., 1985).

3.6 MAJOR ENVIRONMENTS

3.6.1 Physical environment

Exmouth Gulf is located 1400km to the north of Perth, on the arid northwest coast of Western Australia. The Exmouth Gulf represents the transition of the Pilbara and Gascoyne geomorphological units. The open, shallow marine embayment covers some 2,200 km² between latitudes 21°51’ S and 22°31’ S and longitudes 114°05’ E and 114°40’ E, and is situated on a desert coastline (White, 1975b). The Gulf is surrounded by tidal mud flats and ranges in depth from 6 m in the south to 22 m at the mouth (White, 1975b). The western coastline of the Gulf consists largely of sand beaches, which give way to a brief floodplain enclosed to the west by the Cape Range, representative of the Gascoyne. The western coast is comprised of narrow beaches backed by dunes and fronted by sand and rock flats. This shoreline supports a small mangrove community distinct from that found on the eastern shore. With the exception of some sand dunes at Tubridgi Point, the eastern coast has a narrow fringe of dense mangrove thickets bordering extensive salt flats up to 10km in width (McCook et al., 1995), representative of the Pilbara. Occasional islands are found along the eastern coast. These are characteristic low limestone islands with muddy beaches and rock pavement shores. In some areas macroalgal beds and coral, typical of rocky shore communities, cover the intertidal areas. A broad headland divides the hypersaline southern

part of the Gulf into two shallow bays, while a chain of small, low islands are arranged across the open northern end. The continental shelf runs to within 15km of North West Cape, effectively forming a barrier restricting any southward movement of benthic animals (White, 1975a).

The southeastern and eastern regions of the gulf are hypersaline (35-55‰) nursery areas for the resident tiger prawn stock (White, 1975a). Much of the bottom in these areas is either hard substrate supporting algal beds, or highly mobile coarse sediments with very little fine silt and clay (McCook et al., 1995). The low abundance of seagrass in the area sets it apart from the nursery areas supporting juvenile tiger prawn elsewhere in Australia, where seagrass beds are of prime importance (Penn, 1988; Hill and Wassenberg, 1993; Watson and Turnbull, 1993).

Rainfall to the area is extremely low with the average annual rainfall being 300mm. Coupled with the physical geography of Exmouth Gulf the minimal river flow entering the gulf creates a relatively stable hydrological environment (Penn and Caputi, 1985). This state is altered, however, by the occasional occurrence of severe tropical cyclones during the summer and autumn months (December to April). Tropical cyclones with wind speeds in the order of 40-50 knots occur every three to five years, with less intensive systems occurring annually from January through March. These events bring heavy rainfall, and the associated freshwater runoff alters salinity and turbidity. Heavy wave action generated by extreme winds also increases turbidity, while disrupting the coastal zone and marine benthos. Extremely low barometric pressures cause localised flooding from tidal surge (Penn and Caputi, 1986). These cyclonic events have been shown to have major positive and negative impacts on the stocks of tiger prawns in the Gulf, depending on the month they occur and their track through the area (Penn and Caputi, 1986). Tides are semi-diurnal and have a mean tidal range of 1.5 to 2.1m.

Exmouth Gulf has a semi-arid to arid climate with hot, generally dry summers and mild winters. The mean ambient water temperature in Exmouth Gulf ranges from 30°C in the summer (January to March) to as low as 17°C during the winter months (June to August) (Harris, 2000).

3.6.2 Economic environment

The major markets for tiger prawns are Japan and Taiwan where they are sold raw with head on. Australia, Europe, United States of America and Taiwan are the major markets for western king prawns where they are sold cooked with the head on. Endeavour prawns are mainly sold in Australia and New Zealand, cooked with head on. The Fishery has an average annual value to fishers of around \$19 million depending on variable catch levels and composition, market price and exchange rates.

3.6.3 Social environment

The Fishery has had considerable impact on regional WA, particularly the Exmouth township. The 13 licensed vessels operating in this fishery require up to 52 skippers and crew being employed. The EGP fishery employs around 120 people directly (fishing, processing and administration) with some 20 other jobs as an indirect activity (Engineering, Equipment Supplies etc). The packaging used is all manufactured in Perth. Additionally, the product is marketed Australia-wide, but the main volume is through Sydney.

4.0 Outline of reporting process

4.1 SCOPE

This ESD report was generated by assessing “*the contribution of the Exmouth Gulf Prawn fishery to ESD*”. This assessment examined the benefits and the costs of the EGP fishery across the major components of ESD (see Table 1). In doing so, it provides a report on the performance of the fishery for each of the relevant ecological, economic, social and governance issues associated with this fishery. Given the timeframes involved, only the criteria required for the “*Guidelines for the Ecologically Sustainable Management of Fisheries*”, which cover mainly the environmental elements of ESD (outlined below in Table 1) were generated for this report.

Table 1. Main National ESD reporting components.

NB: Only those ESD components in **bold*** are reported in this report.

NATIONAL ESD COMPONENTS
Contribution to Ecological Wellbeing
<i>Retained Species*</i>
<i>Non-Retained Species*</i>
<i>Other Environmental Issues*</i>
Contribution to Human Wellbeing
<i>Indigenous Community Issues</i>
<i>Community Issues</i>
<i>National Social and economic Issues</i>
Ability to Achieve
<i>Governance*</i>
<i>Impact of the environment on the fishery</i>

4.2 OVERVIEW

There were four steps involved in completing the ESD report for the EGP fishery. It was based upon using the National ESD process, which is outlined in detail in the WA ESD policy paper (Fletcher, 2001) and in the “How to Guide” (Fletcher et. al., 2002) located on the fisheries-esd.com.au website:

1. The issues that needed to be addressed for this fishery were determined at a stakeholder workshop. This process was facilitated by adapting the set of “Generic ESD Component Trees” into a set of trees specific to the EGP fishery.
2. A risk assessment/prioritisation process was completed that objectively determined, which of these identified issues was of sufficient significance to warrant specific management actions and hence a report on performance. The justifications for assigning low priority or low risk were, however, also recorded.
3. An assessment of the performance for each of the issues with sufficient risk to require specific management actions was completed using a standard set of report headings where operational objectives, indicators and performance measures, management responses etc. were specified.

4. An overview assessment of the fishery was completed including an action plan for activities that will need to be undertaken to enable acceptable levels of performance to continue or, where necessary, improve the performance of the fishery.

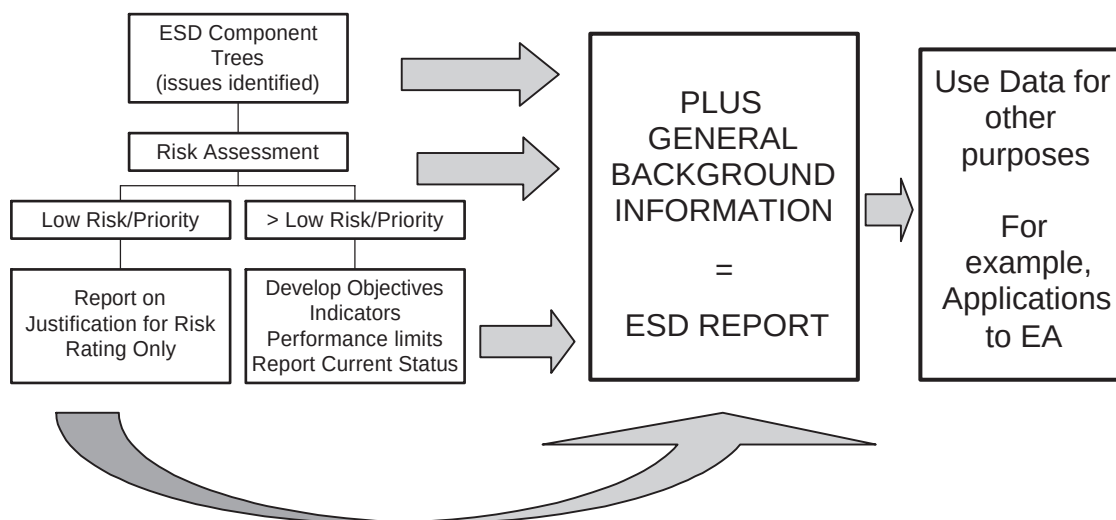


Figure 9. Summary of the ESD reporting framework processes.

4.3 ISSUE IDENTIFICATION (COMPONENT TREES)

The National ESD reporting framework has eight major components, which fall into three categories of the “contributions to ecological wellbeing”, “contributions to human wellbeing” and “ability to achieve the objectives” (Table 1). Each of the major components is broken down into more specific sub-components for which ultimately operational objectives can be developed.

To maximise the consistency of the approach amongst different fisheries, common issues within each of the components were identified by the then SCFA and ESD Reference Groups within each of the major component areas and arranged into a series of “generic” component trees (See Fletcher (2002) and the www.fisheries-esd.com web site for a full description). These generic trees were used as the starting point for identifying the issues. These trees were subsequently adapted into trees specific to the EGP fishery during an open consultative process involving all stakeholder groups. This was achieved by expanding (splitting) or contracting (removing/lumping) the number of sub-components as required (see Fig. 10).

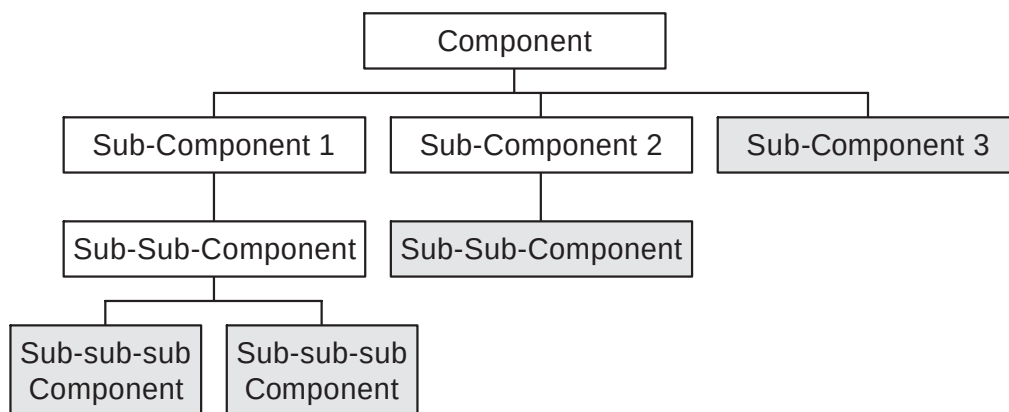


Figure 10. Example of a component tree structure.

The trees for the EGP fishery were developed at a meeting held in June 2001. The stakeholders present during this meeting covered the commercial industry, recreational fishers, environmental groups, local government, Environment Australia, Department of Environmental Protection, Department of Fisheries staff and an independent facilitator (full attendance list in Appendix A3.1).

4.4 RISK ASSESSMENT/PRIORITISATION PROCESS

After the components/issues were identified, a process to prioritise each of these needs was completed using a formal risk assessment process. The risk assessment framework that was applied at the workshop was consistent with the Australian Standard AS/NZS 4360:1999 Risk Management, concentrating on the risk assessment components. The general Risk Assessment process is well documented but in summary, it considers the range of potential consequences of an issue/activity and how likely those consequences are to occur. The combination of the level of consequence and the likelihood is used to produce an estimated level of risk associated with the particular hazardous event/issue in question.

A realistic estimate of the consequence level for each issue was made by the group at the workshop. This level was from 0-5, with 0 being negligible and 5 being catastrophic/ irreversible (see Appendix 4 for details of consequence tables). This assessment was based upon the combined judgement of the participants at the workshop, who collectively had considerable expertise in the areas examined.

The level of consequence was determined at the appropriate scale for the issue. Thus for target species the consequence of the EGP fishery was based at the population level and not the individual level. Obviously catching one fish is always catastrophic for the individual but not always for the population. Similarly, when assessing possible ecosystem impacts this was done at the level of the whole ecosystem or at least in terms of the entire extent of the habitat, not at the level of an individual patch or individuals of non-target species.

The likelihood of a consequence occurring was assigned to one of six levels from remote to likely. In doing so, the workshop group again considered the likelihood of the “hazardous” event (consequence) actually occurring based upon their collective wisdom, which included an understanding of the scale of impact required.

From these two figures (consequence and likelihood), the overall risk value, which is the mathematical product of the consequence and likelihood levels ($\text{Risk} = \text{Consequence} \times \text{Likelihood}$), was calculated. Finally, each issue was assigned a *Risk Ranking* within one of five categories: Extreme, High, Moderate, Low and Negligible based on the risk value (see Table 2).

Table 2. Risk ranking definitions.

RISK	Rank	Likely Management Response	Reporting
Negligible	0	Nil	Short Justification Only
Low	1	None Specific	Full Justification needed
Moderate	2	Specific Management Needed	Full Performance Report
High	3	Possible increases to management activities needed	Full Performance Report
Extreme	4	Likely additional management activities needed	Full Performance Report

Only the issues of sufficient risk (Moderate, High & Extreme), - those that require specific management actions - need to have a full performance report completed. Nonetheless, the rationale for classifying issues as low or even negligible risk was also documented and form part of the ESD report. This allows all stakeholders and interested parties to see why issues were accorded these ratings. This process is summarised in Figure 9.

4.5 COMPONENT REPORTS

Only the issues of sufficient risk or priority that require specific management actions have a full performance report completed (which form Section 5 of this report). Nonetheless, the rationale for classifying issues as low risk/priority was also documented and forms part of the report so that stakeholders can see where all the identified issues have finished.

For each of the lowest level sub-components (assessed as being of sufficient risk/priority to address), a detailed assessment of performance is generated. The then SCFA Working Group in conjunction with the ESD Reference Group has agreed upon a set of 10 standard headings each of which need to be addressed (Table 3). A further heading, “**Rationale for Inclusion**”, has been added to this list. This specific heading allows for the issues raised within the risk assessment process to be explicitly recorded. A full description of each of these headings is located in the ESD policy (Fletcher, 2002), which is available on the WA Fisheries website.

The completion of these component reports was begun at the initial stakeholder workshop back in June 2001. Progress towards completing these reports was subsequently made by a variety of Departmental staff. When a complete set of draft component reports was completed, a second stakeholder workshop was held in October 2001 where these drafts were discussed with all comments, concerns and suggestions from stakeholders subsequently having been incorporated within the current document.

Table 3. The National ESD report headings used in this report.

1. Rationale for Inclusion
2. Operational Objective (+ justification)
3. Indicator
4. Performance Measure (+ justification)
5. Data Requirements
6. Data Availability
7. Evaluation
8. Robustness
9. Fisheries Management Response
 - Current
 - Future
 - ***Actions if Performance Limit exceeded***
10. Comments and Action
11. External Drivers

4.6 APPLICATION TO MEET EPBCA REQUIREMENT

The material generated by the ESD reporting process, which is contained with the risk assessment and performance reports was used to meet the requirements of the Commonwealth Environment Protection and Biodiversity Conservation Act (1999). This involved submitting an application that addressed each of the criteria of the Commonwealth guidelines for the assessment of sustainable fisheries. This information is provided in Appendix 8.

4.7 OVERVIEW TABLE

The following table provides a summary of the material presented in the report.

Issue	Objective Developed ³	Indicator measured	Performance Measure	Current Performance	Robustness	EA Guidelines Covered	
						1.1.1 – 1.1.8	
5.1.1.1 Tiger Prawns	Yes	Level of spawning stock	Catch rate above 8-10 kg/hr	Acceptable	High	1.1.1 – 1.1.7	Continue and improve current monitoring, management and assessment arrangements.
5.1.1.2 King Prawns	Yes	Total Catch	Within acceptable range of 350-500 tonnes.	Acceptable	Medium	1.1.1 – 1.1.7	Continue and improve current monitoring, management and assessment arrangements.
5.1.1.3 Endeavour Prawns	Yes	Total Catch	Within acceptable range of 120 –300 tonnes.	Acceptable	Medium	1.1.8	Continue and improve current monitoring, management and assessment arrangements.
5.1.1.4 Banana Prawns	Yes, but Low Risk	Total Catch	Within acceptable range of 10-60 tonnes for years with significant rainfall and 0-2 tonnes for years with low rainfall.	Acceptable	Medium	1.1.8	Continue and improve current monitoring, management and assessment arrangements.
5.1.2.1 Coral Prawns	Yes, but Low Risk	Total Catch	Within acceptable range of 20 – 100 tonnes.	Acceptable	Medium	1.1.8	Continue and improve current monitoring, management and assessment arrangements.
5.1.2.2 Blue Swimmer Crabs	No-Negligible Risk	N/A	N/A	N/A	N/A	1.1.8	Review risk at next major assessment in 5 years.
5.1.2.3 Squid and Cuttlefish	No-Negligible Risk	N/A	N/A	N/A	N/A	1.1.8	Review risk at next major assessment in 5 years.
5.1.2.4 Sharks	No-Negligible Risk	N/A	N/A	N/A	N/A	1.1.8	Review risk at next major assessment in 5 years.

³ Indicates whether a full report on the performance for the particular issue identified was warranted and developed.

Issue	Objective Developed	Indicator Measured	Performance Measure	Current Performance	Robustness	EA Guidelines Covered	
						1.1.1 – 1.1.8	
5.1.2.5 Bugs	No-Negligible Risk	N/A	N/A	N/A	N/A	1.1.8	Review risk at next major assessment in 5 years.
5.1.2.6 Cobia	No-Negligible Risk	N/A	N/A	N/A	N/A	1.1.8	Review risk at next major assessment in 5 years.
5.1.2.7 Cods	No-Negligible Risk	N/A	N/A	N/A	N/A	1.1.8	Review risk at next major assessment in 5 years.
5.1.2.8 Mackerel	No-Negligible Risk	N/A	N/A	N/A	N/A	1.1.8	Review risk at next major assessment in 5 years.
5.1.2.9 Nor-West Snapper	No-Negligible Risk	N/A	N/A	N/A	N/A	1.1.8	Review risk at next major assessment in 5 years.
5.1.2.10 Other Species	No-Negligible Risk	N/A	N/A	N/A	N/A	1.1.8	Review risk at next major assessment in 5 years.
						2.1, 2.2	
5.2.1.1 Seasnakes	No-Negligible Risk	N/A	N/A	N/A	N/A	2.2.1 – 2.2.6	Review risk at next major assessment in 5 years.
5.2.1.2 Syngnathids	No-Negligible Risk	N/A	N/A	N/A	N/A	2.2.1 – 2.2.6	Review risk at next major assessment in 5 years.
5.2.1.3 Leatherback Turtles	No-Negligible Risk	N/A	N/A	N/A	N/A	2.2.1 – 2.2.6	Review risk at next major assessment in 5 years.
5.2.1.4 Green Turtles	No-Negligible Risk	N/A	N/A	N/A	N/A	2.2.1 – 2.2.6	Review risk at next major assessment in 5 years.
5.2.1.5 Loggerhead Turtles	No-Negligible Risk	N/A	N/A	N/A	N/A	2.2.1 – 2.2.6	Review risk at next major assessment in 5 years.

Issue	Objective Developed	Indicator Measured	Performance Measure	Current Performance	Robustness	EA Guidelines Covered	
5.2.1.6 Flatback Turtles	No-Negligible Risk	N/A	N/A	N/A	N/A	2.2.1 – 2.2.6	Review risk at next major assessment in 5 years.
5.2.1.7 Hawksbill Turtles	No-Negligible Risk	N/A	N/A	N/A	N/A	2.2.1 – 2.2.6	Review risk at next major assessment in 5 years.
5.2.1.8 Discarded Fish	Yes-but Low Risk	Distribution of bycatch species within and outside the trawl grounds	The major species of bycatch are found in significant numbers outside of the trawled areas	An evaluation of this issue will be provided following the completion of the survey	High	2.1.1 – 2.1.6	Introduce 100% BRDs by 2003 and perform a survey of trawled and untrawled areas.
5.2.1.9 Invertebrates	No-Negligible Risk	N/A	N/A	N/A	N/A	2.1.1 – 2.1.6	Review risk at next major assessment in 5 years.
5.2.2.1 Interaction with Dugongs and Cetaceans	No-Negligible Risk	N/A	N/A	N/A	N/A	2.2.1 – 2.2.6	Review risk at next major assessment in 5 years.
5.2.2.2 Interaction with Leatherback Turtles	No-Negligible Risk	N/A	N/A	N/A	N/A	2.2.1 – 2.2.6	Review risk at next major assessment in 5 years.
5.2.2.3 Interaction with Loggerhead Turtles	No-Negligible Risk	N/A	N/A	N/A	N/A	2.2.1 – 2.2.6	Review risk at next major assessment in 5 years.
5.2.2.4 Interaction with Green Turtles	No-Negligible Risk	N/A	N/A	N/A	N/A	2.2.1 – 2.2.6	Review risk at next major assessment in 5 years.
5.2.2.5 Interaction with Flatback Turtles	No-Negligible Risk	N/A	N/A	N/A	N/A	2.2.1 – 2.2.6	Review risk at next major assessment in 5 years.

Issue	Objective Developed	Indicator Measured	Performance Measure	Current Performance	Robustness	EA Guidelines	
GENERAL ENVIRONMENT (component tree)						2.3	
5.2.2.6 Interaction with Hawksbill Turtles	No- Negligible Risk	N/A	N/A	N/A	N/A	2.2.1 – 2.2.6	Review risk at next major assessment in 5 years.
5.3.1.1 Removal of Prawns	No – Low Risk	N/A	N/A	N/A	N/A	2.3.1 – 2.3.5	Review risk at next major assessment in 5 years.
5.3.1.2 Removal of By-product species	No – Negligible Risk	N/A	N/A	N/A	N/A	2.3.1 – 2.3.5	Review risk at next major assessment in 5 years.
5.3.1.3 Removal of all retained and non-retained species	No – Low Risk	N/A	N/A	N/A	N/A	2.3.1 – 2.3.5	Review risk at next major assessment in 5 years.
5.3.1.4 Impact to Mud/shell	Yes, but Low Risk	The percentage of mud/shell habitat of the Exmouth Gulf region that is trawled	<40% of mud/shell habitat in Exmouth Gulf trawled	Acceptable	High	2.3.1 – 2.3.5	Continue management through assurance and compliance.
5.3.1.5 Impact to Coral/Sponge	No – Low Risk	N/A	N/A	N/A	N/A	2.3.1 – 2.3.5	Review risk at next major assessment in 5 years.
5.3.1.6 Impact to Macro-algal	No – Negligible Risk	N/A	N/A	N/A	N/A	2.3.1 – 2.3.5	Review risk at next major assessment in 5 years.
5.3.2.1 Discarding Fish	Yes, but Low Risk	Amount of discards per season and ratio of discards to target catch	Reduction in amount of discards and ratio of discards to target catch from pre-introduction of BRDs levels	Acceptable	Low	2.3.1 – 2.3.5	Introduce 100% BRDs in 2003 and initiate research to monitor amount of discards on a five-year basis.
5.3.3.1 Turbidity	No – Negligible Risk	N/A	N/A	N/A	N/A	2.3.1 – 2.3.5	Review risk at next major assessment in 5 years.
5.3.3.2 Translocation	No – Negligible Risk	N/A	N/A	N/A	N/A	2.3.1 – 2.3.5	Review risk at next major assessment in 5 years.

5.0 Performance reports

5.1 RETAINED SPECIES

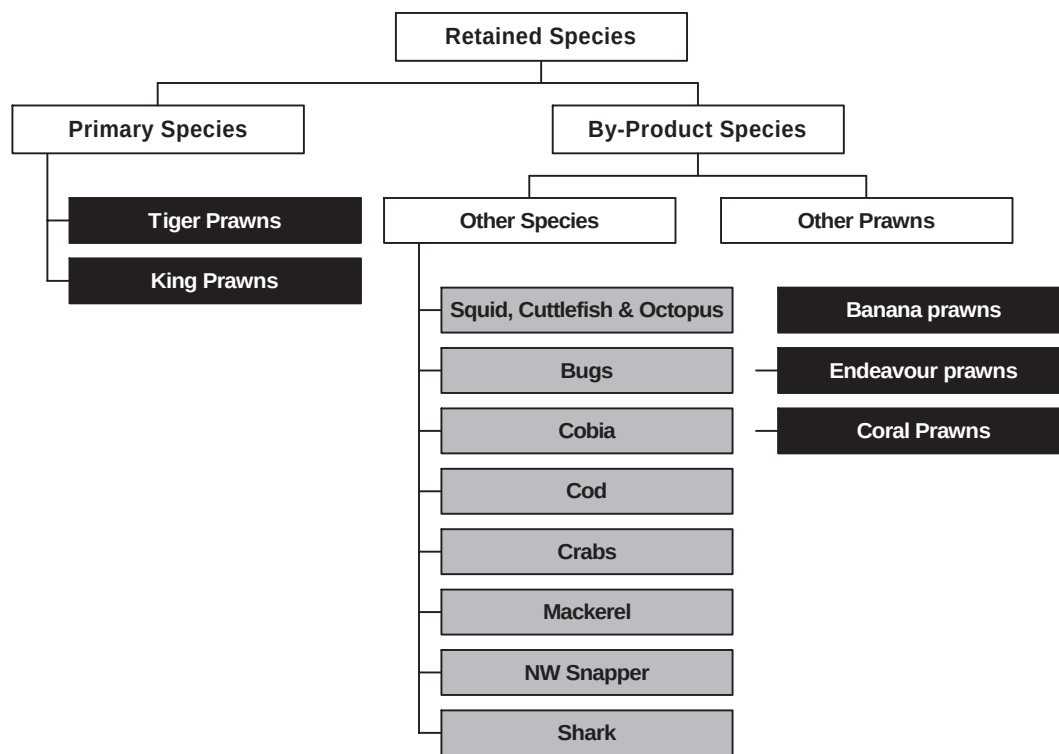


Figure 11. Component tree for retained species.

Black boxes indicate that the issue was considered of high enough risk/priority at the June 2001 Risk Assessment workshop to warrant having a full report on performance. Grey boxes indicate the issue was rated as a low risk and no specific management is required – only justification is presented.

5.1.1 Primary species

5.1.1.1 Tiger prawns

Rationale for inclusion

Tiger prawns are one of the main target species of this fishery. The EGP fishery is capable of taking a relatively large proportion of the stock.

ERA Risk Rating: Impact on breeding populations (C3 L3 MODERATE)

The potential consequence of fishing on tiger prawns was ranked as ‘severe’ (3). Compared to the exploitation of other prawn species in the EGP fishery, this is a relatively high consequence rating. This rating was applied because recruitment of tiger prawns is much more climate dependent than other prawn species and there is some ability to overfish them (note that the tiger prawn stock in Exmouth Gulf was depleted in the 1980s). Rigorous management controls (such as area and seasonal closures etc.) are now in place to minimise the risk of further episodes of overfishing. However, due to the higher risk associated with this species a precautionary approach is taken in assigning a ‘severe’ level

of potential consequence. It was considered ‘unlikely’ that this ‘severe’ consequence could occur, given that a stock depletion event has occurred for this species in the past. This resulted in an overall risk ranking of MODERATE.

Operational objective

To ensure there is sufficient breeding stock to continue recruitment at levels that will replenish what is taken by fishing, predation and other environmental factors by maintaining the spawning stock of tiger prawns at or above a level that minimises the risk of recruitment overfishing.

Justification

Meeting this objective should ensure sufficient spawning stock to continue recruitment at levels that will replenish what is taken by fishing, predation and other environmental factors. This is necessary since there is a relationship between the size of the tiger prawn breeding stock and subsequent levels of recruitment (Caputi, 1993; Penn et al., 1995; Caputi et al., 1998). That is, there will be a level of reduction in stock (and therefore the level of egg production) when recruitment levels are adversely impacted. This phenomenon is often defined as recruitment overfishing. Therefore, as a minimum, the breeding stock (or levels of egg production) should be maintained at levels above where these adverse impacts are likely to occur.

Indicator

Estimates (indices) of the level of spawning stock and the associated level of egg production have been obtained from two programs conducted by the Department of Fisheries:

- Historically this was through the use of a standardised CPUE for the fishery in the main spawning areas (Q1 and Q2, Figure 12) during August through October.
- Since 1982, fishery independent systematic surveys of the breeding grounds (Figure 13) have been undertaken because the spawning area has been closed to fishing for periods both before and during the critical spawning period. The surveys are carried out using commercial vessels that fish to research specifications. Surveys take place in August, September and October.

In addition, recruitment surveys have been systematically conducted in March and April (three sampling periods) since 1985 and provide an index of annual recruitment. Historically this was calculated from catch rates in the fishery and a cohort method (Penn et al., 1995).

Performance Measure

Catch rate of the research surveys of spawning stock should be above 8-10 kg/standardised hr (which currently equates to a catch rate by the fishery of 16 kg/hr for twin gear and 19 kg/hr for quad gear).

Justification

Analysis of catch and effort data in the 1970s and 80s (a period when recruitment was found to have been affected by the low spawning stock that were present) provided evidence to develop a SRR for tiger prawns in Exmouth Gulf (Penn et al., 1995; Caputi et al., 1998). From these data, the appropriate catch rates, which equate to leaving sufficient spawning stock to allow for full recruitment potential has been developed.

The catch rate associated with this performance limit is relatively low, which is appropriate as prawns can be fished to reasonably low abundance levels due to their life history strategies of short life span, high fecundity and high natural mortality (Penn and Stalker, 1979; Dall et al., 1990).

A precautionary approach is now taken with main spawning grounds being closed to fishing once a standardised catch rate threshold of 8 - 10kg/hr by the fleet is reached (which equates to 16kg/hr by current twin gear rigs and 19kg/hr for quad rigs). The assumption is, if the standardised catch rate is less than 8-10kg/hr, the remaining stock of tiger prawns, which will form the spawning biomass for next years recruitment, is likely to be too low to allow optimal recruitment.

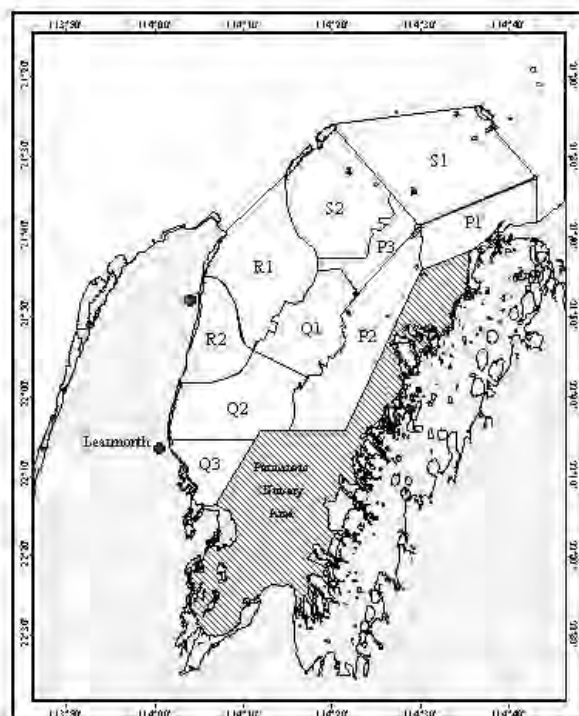


Figure 12. Exmouth Gulf fishing grounds showing key spawning areas Q1 and Q2.

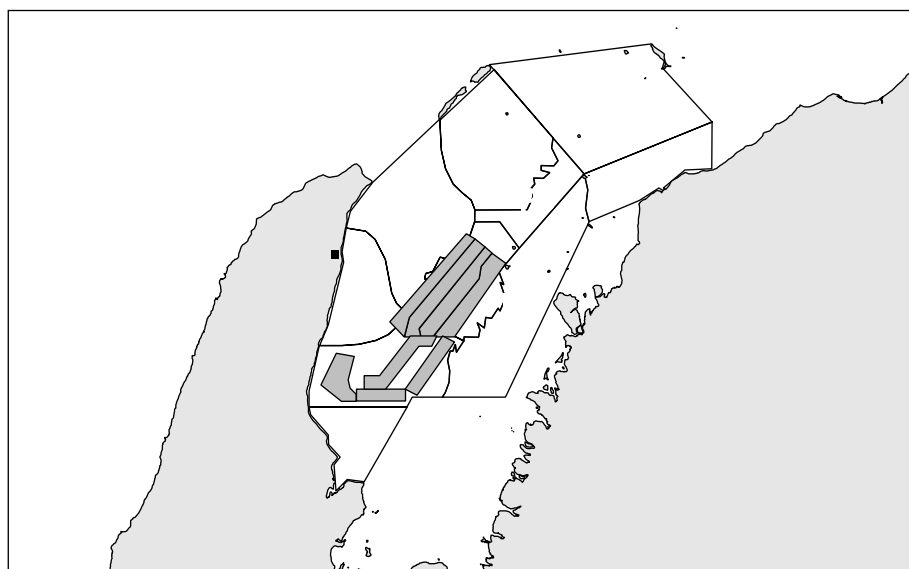


Figure 13. Exmouth Gulf spawning stock survey sites (shaded).

Data requirements for indicator

Data Required	Availability
Fishery independent catch rates and spawning status.	Yes; available on an annual basis since 1984.

Evaluation

Summary: *The current analyses indicate that the tiger prawn fishery breeding stock is at or above the agreed reference point. Consequently, the current performance of the fishery for maintaining a sufficient level of spawning biomass is meeting the agreed objective.*

The catch rates observed in tiger prawn spawning areas have varied between 8 and 25 kg/hr over the last five years and therefore are considered adequate under normal environmental conditions (see Table 4). The high spawning stock levels present in 1999 (25 kg/hr) produced very low recruitment in 2000, as a result of adverse environmental conditions due to cyclonic events. This caused a reduction in the fishing season and catch as well as lower than optimal levels of spawning stock from August to October 2000 despite minimal fishing on recruits. Normal environmental conditions have been experienced during 2000/01 and recruitment levels and overall stock abundance have increased in 2001 (Table 4, Figure 14). A decline and subsequent recovery of the stock has occurred previously during the history of this fishery (Figure 14) and the cause was identified as overfishing in the early 1980s.

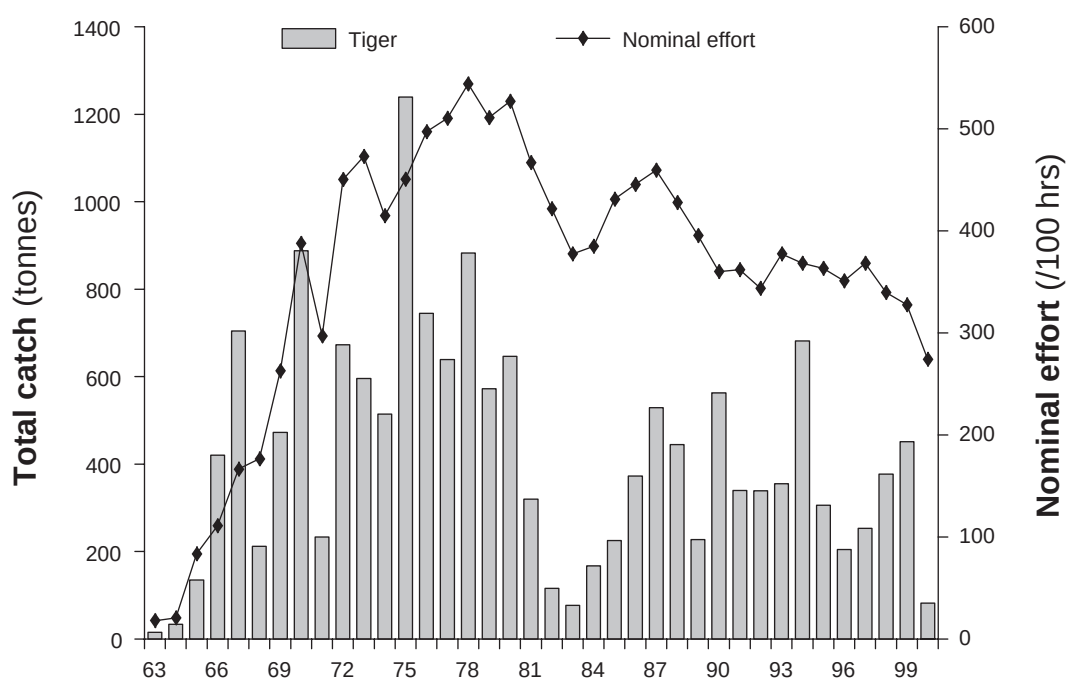


Figure 14. Historical catch and nominal effort for tiger prawns in Exmouth Gulf.

Robustness

High

The estimates, limits and thresholds are considered extremely robust as they:

- provide a statistically demonstrated high degree of confidence,
- are direct estimates of the spawning stock size of tiger prawns,
- are estimates that are calculated by a source independent of the fishers, and
- are based on research that has been reviewed and published in scientific journals.

Fisheries Management Response

Current: To ensure maintenance of the required level of breeding stock:

- The fishery is managed through a series of comprehensive input controls on boat and gear types, designs and materials (See Section 3 for full details).
- Key nursery areas are permanently closed to trawling.
- Real time monitoring of catch and effort completed by department staff.
- The annual fishing season is for a fixed period but has real-time closures in key spawning areas plus area and moon closures directly controlling the effort that can be exerted on the stock.
- Monitoring of improvements in technology that may increase fishing efficiency.

Future:

- Compliance policing will include use of VMS and gear checks.

Close consultation and collaboration with industry and Department of Fisheries to optimise catches and size of prawns being targeted by use of additional surveys.

Actions if Performance Limit is Exceeded:

Within season

If the catch rate of the fleet falls below an average of 19 kg/hr (quad gear equivalent) in key tiger prawn trawl grounds, the area is closed to fishing for the remainder of the season. If the spawning stock surveys later in the season indicate that the rates are significantly above this threshold, the areas may re-open.

End of Season

If the results of the spawning stock survey are below an average of 19 kg/hr then the catch rate that closes the fishery may be increased in the following season. Note that this is a self-correcting mechanism to cope with the situation if the efficiency of the fleet increases.

Table 4. Exmouth Gulf tiger prawn spawning stock indices survey results.

Year	Total Landings	Spawning Q 1	Index Q 2
1984	167	7.5	
1985	226	6.8	
1986	372	7.3	
1987	529	12.2	
1988	445	6.3	
1989	231	4.9	11.0
1990	564	15.4	17.9
1991	340	15.2	19.4
1992	339	15.3	17.7
1993	355	15.1	14.6
1994	682	15.2	30.9
1995	306	6.9	19.0
1996	205	8.0	14.7
1997	253	8.6	16.4
1998	377	10.4	17.4
1999	451	25.1	25.7
2000	82	10.3	7.4
2001	208	16.2	18.9

Comments and action

There is a process of continual improvement in the collection of information and method of analysis. The use of Geographic Information Systems (GIS) for analysing data has commenced in readiness for the introduction of VMS. Furthermore, there is on-going monitoring of environmental sciences and advances that might improve the reliability of estimates as well as the relationships between breeding stock, environmental factors and annual recruitment.

External driver checklist

Environmental factors, such as climatic changes, ocean currents, cyclonic activity and sea-surface temperatures, are known to affect the levels of recruitment of prawns – particularly tiger prawns, and are therefore likely to impact on the level and productivity of breeding stock. The most significant risk factors in the context of external drivers are probably cyclonic activity and significant environmental pollution (i.e. oil or chemical spills in key breeding areas) or habitat degradation.

5.1.1.2 King prawns**Rationale for inclusion**

King prawns are a major target species of the EGP fishery.

ERA Risk Rating: Impact on breeding stocks (C2 L5 MODERATE)

In terms of consequence, the fishery was determined to be currently having only a ‘moderate’ impact on the breeding population level of king prawns. Whilst the fishery catches significant quantities of this species, their biology and dynamics make them more robust to harvesting than tiger prawns

– they mature at smaller sizes and are more widespread. Therefore, the king prawns are at lower risk of recruitment overfishing than tiger prawns. However, with current management designed to harvest relatively large amounts of king prawns it was determined that it was “likely” that the fishery would be having a ‘moderate’ impact.

The impact of taking king prawns on the breeding population is therefore considered ‘moderate’ because this species is explicitly managed to catch high numbers whilst not impacting on subsequent recruitment levels.

Operational objective

To ensure there is sufficient breeding stock to continue recruitment at levels that will replenish what is taken by fishing, predation and other environmental factors by maintaining the spawning stock of western king prawns at or above a level that minimises the risk of recruitment overfishing.

Justification

Although no SRR analysis has been developed for king prawns stocks in Exmouth Gulf, there will be a level of reduction in stock (and therefore the level of egg production) when recruitment levels are adversely impacted. This phenomenon is defined as recruitment overfishing. Therefore, as a minimum, the breeding stock (or levels of egg production) should be maintained at levels above where these adverse impacts are likely to occur.

Indicator

The total catch, taking into consideration the effective effort of vessels operating, is used to assess the level of exploitation of king prawn stocks in Exmouth Gulf.

Performance measure

Given no major change in effort, the status of the king prawn stock is assessed by whether catches remain within the acceptable catch range of 350-500 tonnes.

Justification

Prawns can be fished to reasonably low levels due to their life history strategies of short life span, high fecundity and high natural mortality.

King prawns are the most robust species within this fishery hence the rates of fishing that maintain the spawning biomass of the other species (especially tiger prawns) are well below the levels at which there would be any chance of recruitment overfishing affecting this species. The overall management needs to ensure that the level and distribution of effort both temporally and spatially, optimises the catch of the more robust king prawns whilst not over harvesting the other species.

There is a long time series of catch and effort information for this fishery. Production levels from the 1970s to the 1990s provide no evidence of a SRR for king prawns. Thus, in 1983, the effort on king prawns increased significantly due to the requirement to reduce effort on tiger prawns. Since this time, the annual production of king prawns has improved on average by around 40% due to this increased effort. Whilst it is assumed that this increased production would have decreased the overall spawning stock it did not result in any decline of production other than the normal variations seen in recruitment strength due to environmental factors. This suggests that this stock has never been reduced to levels where this SRR would become evident.

The current catch and effort levels are therefore considered adequate to maintain breeding stocks. This indicates that at current effort levels and with variations in environmental conditions sufficient breeding stock will be available to ensure sufficient recruitment in the future. Furthermore, the introduction of seasonal, moon- and area-closures since this period have provided even more restrictions on the overall fishing effort, which increases the protection of the breeding stocks for king prawns.

Data requirements for indicator

Data Required	Availability
Catch utilising commercial catch and effort information provided through voluntary daily log books completed by 100% of the boats.	Yes; since the mid 1970s.

Evaluation

Summary: The current analysis (Figure 15) of the king prawn fishery breeding stock is at or above the agreed reference point. Consequently, the current performance of the fishery for maintaining a sufficient level of spawning biomass is meeting the agreed objective.

The catches of king prawns are mostly related to the level of effort on the stocks and the normal environmental fluctuations amongst years. Consequently, the catches have generally been within the acceptable range for the last ten years in this fishery. The slightly lower catch in 2000 resulted from a dispersion of stock away from traditional fishing grounds, due to the impacts of the cyclone making them less available to the fleet.

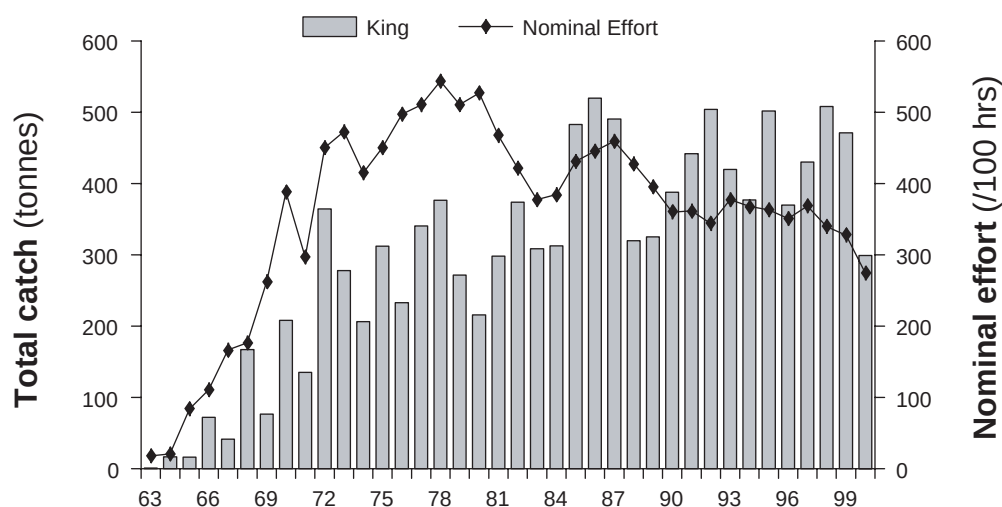


Figure 15. Historical catch of king prawns and nominal effort in EGP fishery.

Robustness

Medium

- The Department of Fisheries has a long time-series of catch and effort information provided accurately by 100% of commercial fishers via daily voluntary log books. The log books are filled in on a shot by shot basis with estimated catch values. These estimates are then validated using processor unload records (actual quantity unloaded). Regular feedback and consultation with industry occurs to ensure they have an understanding of the need and value of accurate catch and effort information.

- Catch may not be an index of abundance as production is affected by the level of effort on the species.
- Research upon which these assumptions are based has been reviewed in scientific journals.

Fisheries management response

Current: To ensure maintenance of the required level of breeding stock:

- The fishery is managed through input controls (including number of boats, power of vessel, controls on net design and other gear restrictions).
- Key nursery areas are permanently closed to trawling.
- The annual fishing season is for a fixed period and includes seasonal, area and moon closures limiting the opportunity to fishers to take prawns.
- Improvements in technology that may increase fishing efficiency are monitored.
- Any significant declines in the breeding population either from environmental effects or due to fishing are observed in time to implement appropriate risk management interventions.

Future:

- Compliance policing will include use of VMS and gear checks.
- Close consultation and collaboration with industry and Department of Fisheries to optimise catches and size of prawns being targeted by use of additional surveys.

Actions if Performance Limit is Exceeded: The following approach is used prior to the beginning of the next season when the performance limit is exceeded:

- Find out why the acceptable catch range has not been met. Evaluate if there has been a shift in the targeting of king prawns that can explain the variation. If the lowered catch levels are due to effort reduction then no action to be taken.
- If there is a drop in the relative abundance of king prawns, strategies available to offer further protection to the breeding stock if required include:
 - Further reductions in the total effort expended in the fishery through a reduction in the length of the fishing season or within season closures; and/or extension of moon closures.
 - Additional area closures.
 - These actions can be initiated within a season or prior to the beginning of the next season.

With fishermen continually improving their fishing efficiency it is likely there will be a need to periodically reduce effective fishing effort through reductions in total number of nights fished and through a reduction in the length of the season and extension of the current length of moon closures.

The ability to implement these strategies is provided for within the FRMA.

Comments and actions

There is a process of continual improvements in the collection of information and method of analysis. The use of GIS systems for analysing data has commenced.

External driver checklist

Environmental factors such as: climatic changes, ocean currents, cyclones and sea-surface temperatures are known to affect the levels of recruitment of prawns and are therefore likely to impact on the level and productivity of breeding stock. The most significant risk factors in the context of external drivers are probably cyclonic activity and significant environmental pollution (i.e. oil or chemical spills in key breeding areas) or habitat degradation.

5.1.1.3 Endeavour prawns

Rationale for inclusion

Endeavour prawns are caught as by-product species in the EGP fishery. These species are not targeted but are caught in reasonable numbers in most years.

ERA Risk Rating: Impact on breeding population (C2 L5 MODERATE)

In terms of potential impact on the breeding stock of endeavour prawns, the consequence of fishing was considered 'moderate'. It was considered likely that this level of consequence would result since the catch of endeavour prawns in some years may be substantial. However, their distribution due to their habitat preference for inshore areas, is mainly in areas that are closed to trawling as these are the nurseries for the king and tiger prawns.

Operational objective

Ensuring there is sufficient breeding stock to continue recruitment at levels that will replenish what is taken by fishing, predation and other environmental factors by maintaining the spawning stock of endeavour prawns at or above a level that minimises the risk of recruitment overfishing.

Justification

Maintaining viable stock levels at the highest possible levels of recruitment. This ensures that the levels of recruitment are only affected by environmental fluctuations not by the level of spawning stock. Having maximal levels of recruitment also optimises the level of catch that can be taken by the fishery and minimises any impacts on other species.

Indicator

Total Catch

The total catch is used to assess the level of exploitation of endeavour prawn stocks.

Performance measure

Catch should remain within an acceptable range of 120 to 300 tonnes (ten-year catch range).

Justification

Endeavour prawns are a by-product species of the Exmouth Gulf prawn fishery and this group of species is not specifically targeted by the fishery. Due to the distribution of this species, which are generally inshore of the main trawl grounds, only a small proportion of this stock is vulnerable to the fishery. The introduction and extension of moon closures in the fishery has increased protection of this species, which is known to have higher catchability during full moon periods (Salini et al., 1990).

Data requirements for indicator

Data Required	Availability
Catch utilising commercial catch and effort information provided through voluntary daily log books completed by 100% of the boats.	Yes; since the mid 1970s.

Evaluation

Summary: *The current analysis (Figure 16) for catches of endeavour prawns has generally been within the acceptable catch range for this species. The controls on fishing effort to protect the tiger prawn breeding stock should enable sufficient protection of the endeavour stocks.*

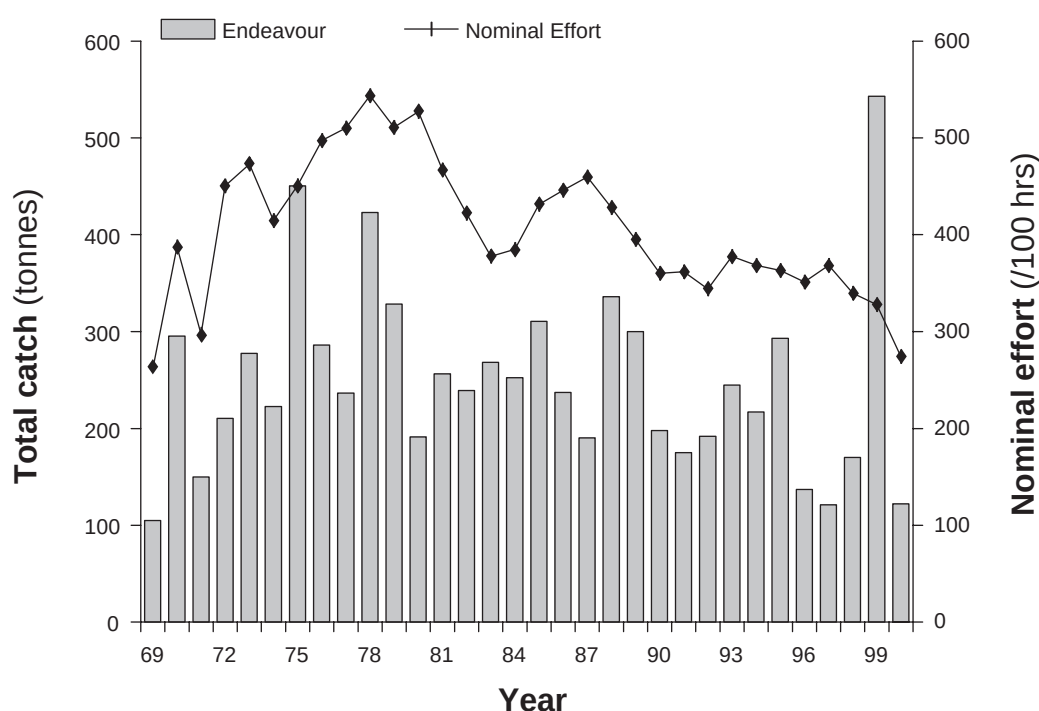


Figure 16. Historical catch of endeavour prawns and nominal effort in EGP fishery.

The annual catch of endeavour prawns over the past 5 years (since the targeting of inshore areas has been reduced – to minimise the capture of small tiger prawns) has generally been around 150t (Figure 16). This range was vastly exceeded in 1999 when Cyclone Vance resulted in substantial quantities of endeavour prawns being moved from inshore areas out onto the main trawl grounds, with the catch being 543t. This was only a one-year phenomenon with the catch in 2000 again returning to the acceptable levels. Thus no further management intervention was required.

Robustness

Medium

- Long time-series of catch and effort information provided by 100% of commercial fishers via daily voluntary log books.
- Catch may not be an index of abundance due to non-targeting of the species.

Fisheries Management Response

Current: Management strategies are in place to protect tiger prawn and king prawn breeding stocks, which also ensure the maintenance of the required level of breeding stock for endeavour prawns. These strategies include:

- The fishery is managed through input controls (see above for details).
- The annual fishing season is for a fixed period and includes seasonal, area and moon closures limiting the opportunity for fishers to take endeavour prawns.
- There are permanent nursery closures over areas where endeavour prawns are common.

Future:

- Compliance policing will include the use of VMS and gear checks.
- Close consultation and collaboration with industry and Department of Fisheries to optimise catches and size of prawns being targeted by the use of additional surveys.

Actions if Performance Limit is Exceeded: The following strategy will be adopted prior to the beginning of the next season in the event that the performance limits are exceeded:

- Find out why the acceptable catch range has not been met or is significantly over the acceptable range. Evaluate if there has been a shift in targeting of endeavour prawns that can explain the variation. If lowered catch levels are due to effort reduction then no action to be taken. If an increase is due to a one-off environmental fluctuations then no action will be taken.
- If there is a significant drop/increase, or a declining/increasing trend over three years in the relative abundance of endeavour prawns, strategies to further protect the breeding stock through further reducing the total effort expended in the fishery (including a reduction in the length of fishing season or within season closures; or an extension of moon closures) will be investigated. These actions can be initiated within a season or prior to the beginning of the next season.

The ability to implement these strategies is provided for within the FRMA.

Comments and action

The use of GIS for analysing data has commenced.

External driver checklist

Environmental factors such as: climatic changes, ocean currents, cyclones and sea-surface temperatures are known to affect the levels of recruitment of prawns and are therefore likely to impact on the level and productivity of breeding stock. The most significant risk factors in the context of external drivers are probably cyclonic activity and significant environmental pollution (i.e. oil or chemical spills in key breeding areas) or habitat degradation.

5.1.1.4 Banana prawns

Rationale for inclusion

Banana prawns are caught as by-product in the EGP fishery. Although the fishery does not target this species they are still caught in reasonable numbers in some years when environmental conditions are suitable.

ERA Risk Rating: Impact on breeding stocks (C1 L5 LOW)

Operational objective

Ensuring there is sufficient breeding stock to continue recruitment at levels that will replenish what is taken by fishing, predation and other environmental factors by maintaining the spawning stock of banana prawns at or above a level that minimises the risk of recruitment overfishing.

Justification

Maintaining the productivity of the banana prawn stock by ensuring that recruitment levels are only affected by environmental fluctuations not by the level of spawning stock.

Indicator

The annual catch of banana prawns.

Performance measure

Catches are highly variable and related to the amount of rainfall recorded in the region with consecutive high rainfall years providing the optimal conditions for banana prawn recruitment. In years where significant rainfall is recorded the acceptable catch range is 10 to 60 tonnes. In years of very low rainfall, the catch of banana prawns is expected to be 0 to 2 tonnes.

Justification

Banana prawns are only targeted in those years when abundance is higher and banana prawn aggregations are evident. Low levels of banana prawn stocks occur in Exmouth Gulf each year but increase only when environmental conditions are favourable. Banana prawns are at their southern limit of distribution in Exmouth Gulf and more regular abundances occur north of Exmouth Gulf.

Daylight bans on trawling has reduced potential effort on bananas, which tend to aggregate during daylight hours. During high abundance years however, a limited level of daylight trawling has been permitted to optimise catch of banana prawns.

Data requirements for indicator

Data Required	Availability
Catch utilising commercial catch and effort information provided through voluntary daily log books completed by 100% of the boats.	Yes; since the mid 1970s.

Evaluation

Summary: *The current analysis (Figure 17) of the banana prawn catches indicates that the breeding stock is at acceptable levels. A higher abundance of banana prawns will occur under optimal environmental conditions.*

The catch of banana prawns in the last five years has varied within the acceptable range (Figure 17). The upper limit was nearly reached in 1999, the year of Cyclone Vance, which provided the favourable conditions for this species (the opposite to tiger prawns).

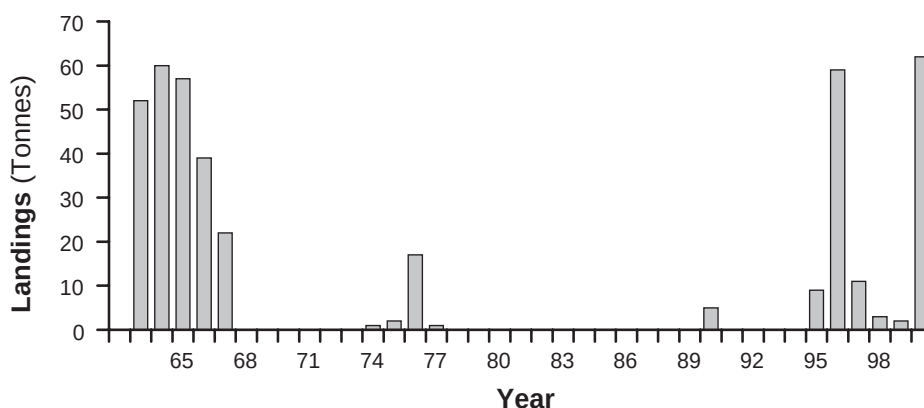


Figure 17. Historical catches of banana prawns in the EGP fishery.

Robustness

Medium

- Long time-series of catch and effort information provided by 100% of commercial fishers via daily voluntary log books.
- Catch may not be the best index of abundance due to non-targeting of the species in most years, but in years of high abundance, these prawns do become evident on the trawl grounds.

Fisheries management response

Current: To ensure maintenance of the required level of breeding stock:

- The fishery is managed through input controls.
- The annual fishing season is for a fixed period and includes seasonal, area and moon closures limiting the opportunity to fishers to take prawns and daylight ban on trawling.
- Compliance policing includes gear checks.
- Monitoring of improvements in technology that may increase fishing efficiency.

Future:

- Compliance policing will include use of VMS and gear checks.
- In years of higher abundance of banana prawns, close consultation and collaboration with industry and Department of Fisheries can optimise catches including daylight trawling.

Actions if Performance Limit is Exceeded: The following strategy will be adopted prior to the beginning of the next season in the event that the performance limits are exceeded:

- Find out why the acceptable catch range has not been met or is significantly over the acceptable range. Evaluate if there has been a shift in targeting of banana prawns that can explain the variation. If lowered catch levels are due to effort reduction then no action to be taken. If an increase is due to a one-off environmental fluctuations then take no action.
- If there is a significant increase, or a increasing trend over three years in the relative abundance of banana prawns, strategies to further protect the breeding stock by further reducing the total effort expended in the fishery (including a reduction in the length of fishing season or within season

closures; or an extension of moon closures) will be investigated. These actions can be initiated within a season or prior to the beginning of the next season.

Comments and action

The use of GIS for analysing data has commenced.

External driver checklist

Environmental factors such as: climatic changes, ocean currents and sea-surface temperatures are known to affect the levels of recruitment of prawns and are therefore likely to impact on the level and productivity of breeding stock. High rainfall years (often associated with cyclones) provide higher banana prawn abundances. The most significant risk factors in the context of external drivers are probably cyclonic activity and significant environmental pollution (i.e. oil or chemical spills in key breeding areas) or habitat degradation.

5.1.2 By-product species

5.1.2.1 Coral prawns

Rationale for inclusion

Coral prawns are caught as a by-product species in the EGP fishery. Although, the fishery does not target this species they are still caught in reasonable numbers from year to year.

ERA Risk Rating: Impact on breeding stocks (C1 L5 LOW)

Operational objective

Ensuring there is sufficient breeding stock to continue recruitment at levels that will replenish what is taken by fishing, predation and other environmental factors by maintaining the spawning stock of coral prawns at or above a level that minimises the risk of recruitment overfishing.

Justification

Maintaining viable stock levels by ensuring that recruitment is only affected by environmental fluctuations not by the level of spawning stock.

Indicator

Catch of coral prawns.

Performance measure

Catch should remain within an acceptable range of 20-100 tonnes (ten-year catch range).

Justification

Coral prawns are a by-product species of the EGP fishery and not targeted by the fishery. Coral prawns are a small species therefore many of them fall through the cod-end mesh and are not retained. It is common for coral prawns to be discarded in preference to higher value prawn species. Due to the mesh size, selectivity and distribution only a small proportion of the stocks are vulnerable to the fishery.

Data requirements for indicator

Data Required	Availability
Catch utilising commercial catch and effort information provided through voluntary daily log books completed by 100% of the boats.	Yes; since the late 1980s.

Evaluation

Summary: The current analysis (Figure 18) indicates that the coral prawn fishery is within the acceptable catch range and the fishery is, therefore, meeting the objective.

The catches of coral prawn stocks for only the past five years have remained within the acceptable catch range for this species.

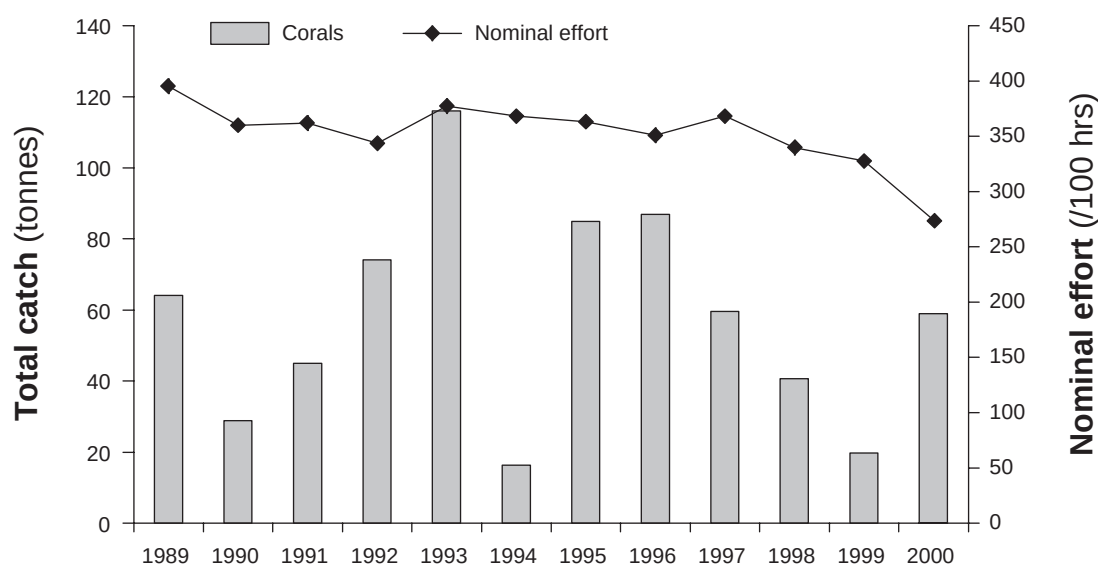


Figure 18. Historical catch (tonne) of coral prawns and overall nominal total effort in the EGP fishery.

Robustness

Medium

- There is a long time-series of catch and effort information provided by 100% of the commercial fishers via daily voluntary log books.
- Data are aggregated for several species termed coral prawns.
- Catch may not be an index of abundance due to the practise of discarding when more valuable species are caught in high quantities and selectivity of trawl nets precludes catch of a proportion of individuals.

Fisheries management response

Current: To ensure maintenance of the required level of breeding stock:

- The fishery is managed through input controls.
- The annual fishing season is for a fixed period and includes seasonal, area and moon closures limiting the opportunity for fishers to take prawns.
- Compliance policing includes use of VMS and gear checks.
- Monitoring of improvements in technology that may increase fishing efficiency.

Future: It is not anticipated that coral prawns will be targeted by fishers due to the low economic value of this species compared to tiger and king prawns.

Actions if Performance Limit is Exceeded: The following strategy will be adopted prior to the beginning of the next season in the event that the performance limits are exceeded:

- Find out why the acceptable catch range has not been met or is significantly over the acceptable range. Evaluate if there has been a shift in targeting of coral prawns that can explain the variation. If lowered catch levels are due to effort reduction then no action to be taken. If an increase is due to a one-off environmental fluctuation then take no action.
- If there is a significant drop/increase, or a declining/increasing trend over three years in the relative abundance of coral prawns, strategies to further protect the breeding stock by further reducing the total effort expended in the fishery (including a reduction in the length of fishing season or within season closures; or an extension of moon closures) will be investigated. These actions can be initiated within a season or prior to the beginning of the next season.

The ability to implement these strategies is provided for within the FRMA.

Comments and action

The use of GIS for analysing data has commenced.

External driver checklist

Environmental factors such as: climatic changes, ocean currents, cyclones and sea-surface temperatures are known to affect the levels of recruitment of prawns and are therefore likely to impact on the level and productivity of breeding stock. Similarly, the level of predators and competing scavengers within the ecosystem may also impact the breeding stock levels.

5.1.2.2 Blue Swimmer crabs

Rationale for inclusion

The EGP fishery catches and retains blue swimmer crabs (*Portunus pelagicus*) as by-product.

ERA Risk Rating: Impact on breeding populations (C0 L5 NEGLIGIBLE)

The catch of blue swimmer crabs by the EGP fishery has ranged between 2 t in 1995 and 42 t in 1999, with an average catch of 17 t over this period. The risk assessment determined that it was 'likely' that the Fishery would only be having a 'negligible' impact on the breeding stock levels of blue swimmer crabs, resulting in an overall 'negligible' risk ranking, due to the following:

- In Western Australia blue swimmer crab distribution extends from Albany to the Northern Territory border, and the crabs inhabit a wide range of inshore and continental shelf areas, from the intertidal zone to at least 50 m in depth (Department of Fisheries WA, 2002).
- There is a comparatively limited area where blue swimmer crabs are caught by trawlers. There are

extensive refuge areas both north and south along the coast and in deeper waters of the continental shelf that are generally not fished where the blue swimmer crab can be found.

- The Exmouth Gulf Prawn Managed Fishery takes only a very small proportion of the total catch of blue swimmer crabs. In the season of 2000/2001 the commercial fisheries around the State took 673 tonnes of blue swimmer crabs.
- As the legal size at first capture is well above the size at maturity, in all commercial (and recreational) sectors that take blue swimmer crabs, the breeding stock levels are expected to be adequate to maintain stocks (Fisheries WA, 2002).
- Some crabs are thrown back, particularly undersized individuals. Many of the crabs hauled up in the trawl nets are still alive, and the survival of discarded individuals is generally estimated to be around 85%, based on experimental trawls in Cockburn Sound (Melville-Smith et al. 2001).

5.1.2.3 Squid and cuttlefish

Rational for inclusion

The EGP fishery catches and retains squid and cuttlefish as by-products.

ERA Risk Rating: Impact on breeding populations (C0 L5 NEGLIGIBLE)

Catches of squid have ranged between 6 tonnes in 1990 and 19 tonnes in 1995. The average over the last 10 years is approximately 13 tonnes. Catches of cuttlefish have ranged between 0.3 tonnes in 1999 and 2 tonnes in 1994. The average over the last 10 years is approximately 1 tonne.

In terms of impact on breeding stock levels of squid and cuttlefish, the consequence of the EGP fishery is considered negligible. This is due to the small and isolated catch in comparison to the extensive population size and distribution of cephalopods along the Western Australian coastline.

While the species composition of cuttlefish in Exmouth Gulf is not known, Adam (1979) reviewed the cuttlefish present in Western Australia, which indicates that the Exmouth Gulf populations are a small proportion of the total ranges of these species.

Cuttlefish have short life spans, in the order of 1-2 years. For example, *Sepia apama* requires a single year to reach adult size. Mass mortalities after spawning have been reported (Lu, 1998). However, breeding aggregations of cuttlefish are not known to occur in Exmouth Gulf.

In addition, cuttlefish are most common where there are structured habitats such as rock outcrops and seagrass beds, which provide diversity and protection. Therefore, a significant proportion of the populations in Exmouth Gulf are not vulnerable to trawling (*Dr Fred Wells*, pers. comm.*). Furthermore, permanent closures in the EGP fishery mean that much of the potential trawl area is not in fact fished, further protecting the species.

Worldwide, loliginid squids constitute major molluscan fisheries worth millions of dollars. The standing stock on the North West Shelf has been estimated at 4,500 tonnes (Liu and Yeh, 1984). Loliginids typically mature in one year or less. Their lifespan is short, 1-2 years, ranging up to 4 years in some species. *Sepioteuthis lessoniana* reaches sexual maturity in less than 100 days in Queensland (Dunning & Lu, 1998).

It terms of the risk assessment it was determined that it is likely that the EGP fishery was having only a negligible impact in this respect, resulting in an overall 'negligible' risk ranking for this issue.

* Dr Fred Wells, Senior Curator of Molluscs, WA Museum.

5.1.2.4 Sharks

Rationale for inclusion

The EGP fishery catches and retains sharks as by-product.

ERA Risk Rating: Impact on breeding population (C0 L5 NEGLIGIBLE)

The risk assessment determined that it was likely that the Fishery would be having a negligible impact on the breeding stock levels of sharks in Exmouth Gulf, resulting in an overall negligible risk ranking, due to the following:

- The catch of sharks is very minimal and has ranged between 2 and 13 tonnes with an average take of 5 tonnes per year. This is made up of more than one species, so that the take of any one species would be even lower. Looking at the overall population size, only a small and insignificant amount of sharks is taken by trawlers (R. McAuley*, pers. comm.).
- The introduction of grids into the Fishery in 2002/03 will further reduce the ability of trawlers to catch sharks.
- Sharks are managed under the North Coast Shark Fishery and will be considered separately in this assessment process. In relation to the overall population size and the comparatively large amount caught in dedicated shark fisheries the amount of shark taken by trawlers is insignificant.

5.1.2.5 Bugs

Rationale for inclusion

The EGP fishery catches and retains bugs (*Thenus orientalis*) as by-product.

ERA Risk Rating: Impact on breeding population (C0 L5 NEGLIGIBLE)

Due to the extensive population size and wide geographical range of these species it is unlikely that trawling would impact on bug populations. Bugs have a long larval life and an offshore phase allowing them to disperse widely. Generally, bugs are caught in the centre and northern portion of Exmouth Gulf. Anecdotal evidence suggests that boats seem to get higher catches earlier in the season (when fishing Area A) and then the catches drop to a few per boat per night at the end of the season. The catch of bugs has ranged from only 15 kg in 1985 to 1,315 kg in 1996. In 2000, this fishery caught 642 kg of bugs.

5.1.2.6 Cobia

Rationale for inclusion

The EGP fishery catches and retains cobia (*Rachycentron canadum*) as by-product.

ERA Risk Rating: Impact on breeding population (C0 L5 NEGLIGIBLE)

This species is taken by wetline and by trawl. The level of catch by trawl is not likely to have any impact on the stock. The introduction of bycatch reduction devices in 2002/03 will further reduce the amount of fish taken by trawl.

* Rory McAuley, Shark Research Section, Department of Fisheries, WA.

5.1.2.7 Cods

Rationale for inclusion

The EGP fishery catches and retains cods (Family Serranidae) as by-product.

ERA Risk Rating: Impact on breeding population (C0 L5 NEGLIGIBLE)

This species is taken by wetline and trawl. The level of catch by trawl is not likely to have any impact on the stock. The introduction of bycatch reduction devices in 2002/03 will reduce the amount of fish taken by trawl.

5.1.2.8 Mackerel

Rationale for inclusion

The EGP fishery catches and retains mackerel (Family Scombridae) as by-product.

ERA Risk Rating: Impact on breeding population (C0 L5 NEGLIGIBLE)

This species is taken by wetline and by trawl. The level of catch by trawl is not likely to have any impact on the stock. The introduction of bycatch reduction devices in 2002/03 will reduce the amount of fish taken by trawl.

5.1.2.9 Nor-west snapper

Rationale for inclusion

The EGP Fishery catches and retains nor-west snapper (*Lethrinus* species) as by-product.

ERA Risk Rating: Impact on breeding population (C0 L5 NEGLIGIBLE)

This species is taken by wetline and trawl. The level of catch by trawl is not likely to have any impact on the stock. The introduction of bycatch reduction devices in 2002/03 will reduce the amount of fish taken by trawl.

5.1.2.10 Other species

Rationale for inclusion

The EGP fishery catches and retains other species, such as curio specimens (shells and fish etc.) in very small numbers.

ERA Risk Rating: Impact on breeding population (C0 L5 NEGLIGIBLE)

Due to the very small numbers of such curio individuals that are likely to be taken by the EGP fishery, the impact of this on the breeding populations of these species was considered 'likely' to be 'negligible'.

The Specimen Shell and Marine Aquarium Fish Managed Fisheries also cover the Exmouth Gulf area. These fisheries will be considered separately in this assessment process.

5.2 NON-RETAINED SPECIES

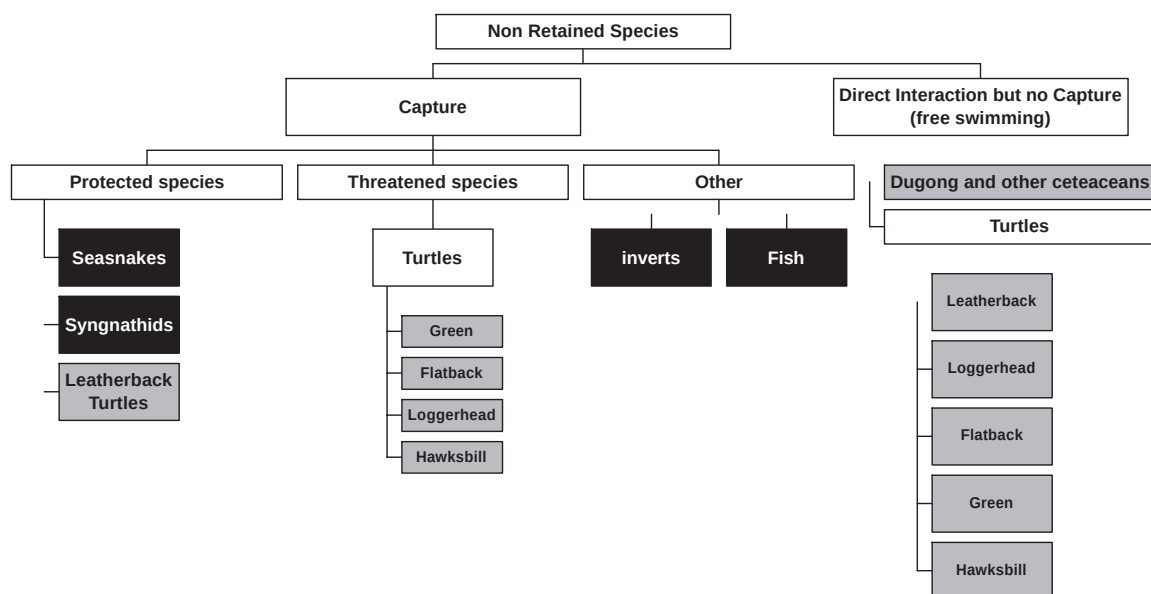


Figure 19. Component tree for the non-retained species.

Black boxes indicate that the issue was considered high enough risk at the June 2001 Risk Assessment workshop to warrant having a full report on performance. Grey boxes indicate the issue was rated as a low risk and no specific management is required – only justification is presented.

5.2.1 Captured in nets

5.2.1.1 Protected species – seasnakes

Rationale for inclusion

Seasnakes are caught by the EGP fishery.

Six of the 22 species known to occur in Western Australia have been recorded in Exmouth Gulf, including *Aipysurus pooleorum*, which is endemic to the region.

ERA Risk Rating: Impact on breeding population (C0 L5 NEGLIGIBLE)

During the risk assessment workshop, this component was considered a ‘negligible’ risk (indicating that only a brief justification report is required), due to the following:

- Anecdotal evidence suggests that caught seasnakes are alive and aggressive (thought to be an indication of health and lack of damage from the trawl);
- A study of seasnake survival after being caught by trawlers in the Gulf of Carpentaria indicated that 60% of seasnakes survived (Wassenberg et al., 1994);
- Most species are considered abundant or common in Exmouth Gulf and are not known to be vulnerable; and
- Seasnakes are only caught occasionally by the trawlers.

5.2.1.2 Protected species – Syngnathids

Rationale for inclusion

Syngnathids collectively refer to the group of organisms such as seahorses, sea dragons and pipefish. Syngnathids are incidentally caught in this fishery and are generally removed from the codend dead. Syngnathids are a protected species under the *Environment Protection and Biodiversity Conservation Act 1999*.

ERA Risk Rating: Impact on breeding population (C1 L2 LOW)

The potential consequence of the prawn trawling operations on breeding levels of syngnathids was considered ‘minor’. Anecdotal evidence from observer program results has suggested that very low numbers of syngnathids are caught by this fishery, in the order of 1 per night across the whole fleet. Furthermore, it is suggested that the occurrence of syngnathids appears to be area specific and often syngnathids may not be caught for many nights in a row. As a result, this number (1 syngnathids per night across the fleet) is more indicative of an average for the season. It was considered ‘unlikely’ that even a negligible level of consequence would result, as trawling occurs over areas that are mostly unfavourable to syngnathids, which are known to favour seagrass, and detached algae communities.

Opportunistic data will be collected on the catch of syngnathids, by observers and other technical staff on the vessels from time-to-time. This data will continually be compiled to determine a better profile of syngnathid catches in this fishery.

5.2.1.3 Protected species – Leatherback turtles

Rationale for inclusion

Leatherback turtles (*Dermochelys coriacea*) are a protected species under Commonwealth legislation and are found in Exmouth Gulf.

ERA Risk Rating: Impact on breeding population (C0 L5 NEGLIGIBLE)

In terms of the impact of the EGP fishery on the leatherback turtle breeding population, the risk assessment determined that it was ‘likely’ that the Fishery would have a ‘negligible’ impact.

Exmouth Gulf is approaching the southern end of the distributional range of the leatherback turtle. Leatherback turtles are quite uncommon in Exmouth Gulf. There are no known breeding locations in Exmouth Gulf and it is assumed that nesting occurs in the Indonesian Archipelago.

There have been no reported captures of leatherback turtles in the trawl gear for the EGP fishery over the 40-year history of the Fishery. However, leatherback turtles have been captured in other northern trawl fisheries. Drift nets and longlines in remote northern waters have also been known to take leatherback turtles. Such activities are thought to have contributed to the decline of nesting populations overseas.

Since leatherback turtles feed primarily on jellyfish they are only likely to occur in Exmouth Gulf following a jellyfish aggregation.

The primary bycatch reduction devices are to be introduced (on one side) to the Fishery in the 2002 season. The fleet fished with 100% BRDs at the start of the 2003 season. It is expected that this will effectively prevent the capture of any turtle in the Fishery altogether.

5.2.1.4 Threatened/listed species – Green turtles

Rationale for inclusion

Green turtles (*Chelonia mydas*) are considered a vulnerable species under Commonwealth and the equivalent under State wildlife conservation legislation as a result of the current status of their populations. They are an inhabitant of Exmouth Gulf waters.

ERA Risk Rating: Impact on breeding population (C0 L5 NEGLIGIBLE)

In terms of the impact of the EGP fishery on the green turtle breeding population, the risk assessment determined that it was 'likely' that the Fishery would have a 'negligible' impact. This is based on the knowledge that green turtles are by far the most abundant turtles in Exmouth Gulf and have a large distributional range outside of Exmouth Gulf. Similarly adult green turtles are herbivorous and therefore are likely to forage in the shallow seagrass and macroalgal beds that are predominantly closed to trawling.

There have been very few reported captures of green turtles in the trawl gear over the 40-year history of the Fishery. These turtles were returned alive to the water and were observed swimming away.

The primary bycatch reduction devices are to be introduced (on one side of the net) to the Fishery in the 2002 season. The fleet will fish with 100% BRDs by the 2003 season. It is expected that this will effectively prevent the capture of any turtle in the Fishery altogether.

5.2.1.5 Threatened/listed species – Loggerhead turtles

Rationale for inclusion

Loggerhead turtles (*Caretta caretta*) are considered endangered species under Commonwealth and the equivalent under State wildlife conservation legislation as a result of the current status of their populations and are an inhabitant of Exmouth Gulf waters.

ERA Risk Rating: Impact on breeding population (C1 L4 LOW)

In terms of the impact of the EGP fishery on the loggerhead turtle breeding population, the risk assessment determined that it was 'likely' that the Fishery would have a 'minor' impact.

Loggerhead turtles are relatively less common than green turtles in Exmouth Gulf but have a wide distributional range. Loggerheads are generally found within shallow waters however they prefer to forage over open substrate such as the mud/shell substrate that dominates the trawl grounds in Exmouth Gulf.

Regardless, there has been very few reported captures of loggerhead turtles in the trawl gear over the 40-year history of the Fishery. These turtles were returned alive to the water and were observed swimming away. However, it has been suggested for other trawl fisheries that loggerheads may be susceptible to reflex asphyxiation rather than drowning during extended periods of submersion (in the trawl net). The relatively long tow times in this fishery may therefore increase the risk of death for loggerhead turtles caught in trawl gear.

The primary bycatch reduction devices are to be introduced (on one side) to the Fishery in the 2002 season. The fleet will fish with 100% BRDs by the 2003 season. It is expected that this will effectively prevent the capture of any turtle in the Fishery altogether.

5.2.1.6 Threatened/listed species – Flatback turtles

Rationale for Inclusion

Flatback turtles (*Chelonia depressus*) are considered a vulnerable species under Commonwealth legislation and are found in Exmouth Gulf.

ERA Risk Rating: Impact on breeding population (C0 L5 NEGLIGIBLE)

In terms of the impact of the EGP fishery on the flatback turtle breeding population, the risk assessment determined that it was ‘likely’ that the Fishery would have a ‘negligible’ impact.

Exmouth Gulf is at the southern limit of the flatback turtle’s distributional range therefore they are relatively uncommon. There are no known breeding locations in Exmouth Gulf. Regardless, given the flatback turtles preferred diet and foraging behaviour it is likely that they may occur on the trawl grounds.

However, there have been very few reported captures of flatback turtles in the trawl gear over the 40-year history of the Fishery. Despite the longer towing time in the EGP fishery (compared to the Shark Bay Prawn Managed Fishery) these turtles were landed, returned to the water alive and observed swimming away.

The primary bycatch reduction devices are to be introduced (on one side) to the Fishery in the 2002 season. The fleet will fish with 100% BRDs by the 2003 season. It is expected that this will effectively prevent the capture of any turtle in the Fishery altogether.

5.2.1.7 Threatened/listed species – Hawksbill turtles

Rationale for inclusion

Hawksbill turtles (*Eretmochelys imbricata*) are considered a vulnerable species under Commonwealth legislation and are found in Exmouth Gulf.

ERA Risk Rating: Impact on breeding populations (C0 L5 NEGLIGIBLE)

In terms of the impact of the EGP fishery on the hawksbill turtle breeding population, the risk assessment determined that it was ‘likely’ that the Fishery would have a ‘negligible’ impact.

Exmouth Gulf is well within the distributional range of the hawksbill turtle however they are relatively uncommon. The hawksbill turtle prefers foraging over hard coral and rock substrate so the turtles are unlikely to occur on the trawl grounds. Most of the trawling in Exmouth Gulf occurs over mud/shell substrate. The coralline and rock substrates are generally outside of the trawl areas – however, trawlers actively avoid these areas anyway given the potential for damage to the gear by hard bottoms.

There have been no reported captures of hawksbill turtles in the trawl gear over the 40-year history of the Fishery.

The primary bycatch reduction devices are to be introduced (on one side) to the Fishery in the 2002 season. The fleet will fish with 100% BRDs by the 2003 season. It is expected that this will effectively prevent the capture of any turtle in the Fishery altogether.

5.2.1.8 Discarded fish

Rationale for inclusion

Trawling contributes to the mortality of several non-commercial fish species that are incidentally caught and die due to the damage and disturbance they experience in the trawl net or from being out of water during the sorting process. These fish are discarded overboard, usually dead. In terms of volume, the sum of these species killed and returned overboard, is between 2 and 5 times the annual prawn catch for the EGP fishery.

Small species of fish make up about the majority (at least approximately 70-80%) of the bycatch (Dr. S. Newman*, pers. comm.). The impact from this source and level of mortality on the sustainability of those species is addressed here.

ERA Risk Rating: Impact on breeding population (C1 L4 LOW)

During the risk assessment workshop, the risk to these discarded fish species was considered collectively. Using this method, the consequence of an impact to breeding populations of bycatch species, by the activity of trawling was considered 'low'. It is important to note that this risk ranking is lower than that determined for the Shark Bay Prawn Managed Fishery because the EGP fishery has relatively lower levels of bycatch. The sustainability of this level of catch was assumed given the relatively small area fished compared to the overall area where these species probably occur.

Following the risk assessment workshop, the Department of Fisheries undertook an assessment of the risk to individual discarded fish species taken in the Shark Bay Prawn fishery. This was undertaken according to the same criteria developed and applied by Stobutzki et al. (2000) in the Northern Prawn Fishery.

Only two species of the 21 most commonly caught species (the spiny headed flounder *Engyprosopon grandisquamum*, and the heart headed flathead *Sorsogona tuberculata*), rated highly susceptible to trawling using the criteria. However, these species have high recovery rates and therefore the risk associated with fish bycatch was still rated as minor. They are also presumed to occur in areas outside of the trawled area.

In summary, of the small fish that are caught and discarded, very few are subject to other fishing mortality; therefore the trawl fishery is the only known human activity directly impacting the species. Juvenile fish caught by trawlers, have a naturally high mortality rate and as such the fishing mortality is thought to have little additive impact on this rate. Furthermore, as such species are generally only taken by trawling, maintaining a trawl impact of less than 40% of the stock can be expected to keep all of the individual stocks above the maximum reference point of 0.4 of virgin biomass for most finfish species.

The introduction of secondary bycatch reduction devices such as square mesh panels in the net will reduce the overall amount of small fish caught and is expected to substantially reduce some select species.

* Dr Steve Newman, Department of Fisheries, WA – Research

Operational objective

To ensure that there are adequate refuge areas provided within Exmouth Gulf, for species that are caught and discarded by the EGP fishery.

Justification

Regardless of the level of impact on discarded fish species within the trawl grounds, if an adequate proportion of the populations of these species are located outside the trawl area, then this should ensure their sustainability.

Indicator

Distribution of bycatch species within and outside the trawl grounds.

Information on the distribution of bycatch species (in particular the 2 more vulnerable species) both within and outside the area of trawling from a research survey of the region will indicate the proportion of the region that provides a refuge to these species from trawling.

Performance measure

The major species of bycatch are found in significant numbers outside of the trawled areas.

Justification

The Department of Fisheries will undertake a survey of species within and outside the trawl grounds to determine the proportion of refuge for bycatch species.

Data requirements for indicator

Data Required	Availability
Detailed daily commercial log books provide information on fishing locations by latitude and longitude for each trawl shot which can be used in GIS analysis.	Yes: available since 1998.
VMS data. Each boat can be polled for location at regular intervals according to compliance protocols and this information can be utilised in spatial analysis.	Available in 2002.
Distribution of bycatch species within the Exmouth Gulf region.	To be determined through bycatch distribution survey.

Evaluation

An evaluation of this issue will be provided following the completion of the survey.

Robustness

High

- Compliance policing includes use of the VMS, which can validate the voluntary log book records and gear checks.
- Scientifically assessed methodology for undertaking the survey.

It should be noted that the interpretation of the survey data is critical due to the large degree of background variation in the natural systems, which will be investigated.

Fisheries management response

Current: To ensure maintenance of the required level of breeding stocks of non-target species:

- The Fishery is managed through input controls that limit the number of boats and the types of gear.
- The annual fishing season is for a fixed period and includes seasonal, area and moon closures limiting total effort on all species.
- Compliance policing includes use of VMS and gear checks.
- Development of a Bycatch Action Plan.
- Introduction of primary and secondary bycatch reduction devices in 2002 and 2003, respectively.

Future: Implementation of grids and secondary bycatch reduction devices during 2002/03 will reduce the overall bycatch taken, particularly small fish species. Preliminary trials indicate the potential to reduce some species by around 50%.

Trawl studies focussing on the biodiversity of trawled and untrawled areas in Exmouth Gulf will provide additional information on the distribution of fish species, particularly for those species that appear to be more susceptible to trawling.

Total swept area calculations are currently made each season using the overall number of hours trawled, average headrope length and spread of the gear. The use of GIS for analysing data has commenced and annual monitoring of the spatial extent and swept area can be made.

Actions if Performance Limit is Exceeded: Strategies available to offer further protection to bycatch if required include expanding the system of area closures or further modifications to trawl gear to reduce bycatch levels.

Comments and action

Given the relatively low risk associated with this issue, the Department of Fisheries will develop the proposal and complete the survey during the next five years.

External driver checklist

Environmental factors such as: climatic changes, ocean currents and sea-surface temperatures are known to affect the levels of recruitment of all fish species, including bycatch species.

5.2.1.9 Invertebrate species

Rationale for inclusion

The shallow regions of Exmouth Gulf support a diverse and abundant invertebrate community. The trawl gear used in this fishery makes contact with the sea bottom where many of these species reside, requiring an assessment to be made of the significance of this interaction.

ERA Risk Rating: Impact on breeding population (C0 L5 NEGLIGIBLE)

It was only considered ‘possible’ that the EGP fishery could even have a ‘negligible’ impact on invertebrate breeding populations in Exmouth Gulf. This low ranking is due to the following:

- Anecdotal evidence suggests that the trawl areas of Exmouth Gulf are typically mud bottom and contain few large invertebrates.
- The trawl gear is configured in a manner that largely precludes the capture of invertebrate species living on or in the substrate. There is a gap of approximately 20 centimetres between the ground chain and the footrope of the net. This is designed to reduce damage to the net through contact with the ground and specifically serves to minimise the capture of immobile and slow moving benthic organisms (and inanimate objects).
- Immobile and slow moving benthic species generally pass through the gap between the ground chain and the footrope. By contrast, mobile species (such as prawns) are disturbed by the ground chain and move up into the water column above the footrope and are subsequently caught in the net.
- Anecdotal evidence suggests that large immobile organisms (such as sponges and other inanimate objects), which do not fit between the gap may occasionally become lodged at the ground chain/footrope interface. However, such items fall free once the net is hauled.
- Some large immobile organisms may also be ‘flicked’ up into the water column by the ground chain and subsequently captured in the net. The grids currently being trialed in Exmouth Gulf have a bottom escape opening to facilitate the removal of such organisms (and inanimate objects).

As detailed above, the Department of Fisheries will be undertaking a survey of bycatch species throughout Exmouth Gulf in order to ensure that bycatch species are adequately represented outside the trawl grounds to ensure sufficient refuge for these species. This survey is likely to provide similar information on the distribution both within and outside trawl areas, of other invertebrate species. This report will be reviewed following the completion of that study.

5.2.2 Interaction but no capture

5.2.2.1 Protected species – Dugongs and cetaceans

Rationale for inclusion

Dugongs and cetaceans do occur in Exmouth Gulf but abundances are generally not as high as in Shark Bay. Dugongs are a protected species under Commonwealth and State legislation and any impacts as a result of this Fishery are to be managed and reduced.

ERA Risk Rating: Impact on breeding populations (C1 L3 LOW)

The interactive impact (as opposed to impact of capture) that prawn trawling activities have on the breeding populations of dugongs and cetaceans in Exmouth Gulf are considered negligible. This conclusion is based on the operational aspects of the trawling activities and the behavioural characteristics of dugongs and cetaceans.

Firstly, trawlers do not operate at speeds greater than around four (4) knots. At such relatively low speeds it is highly unlikely that any cetacean would come in direct contact with a trawler or the gear being towed because they would be able to actively remove themselves from the path. Direct physical interactions are more likely to occur with fast moving recreational craft.

Specifically, in the case of dugongs there is anecdotal evidence to suggest that the trawl grounds in Exmouth Gulf and dugong habitat (which generally refers to the seagrass habitats permanently closed to trawling activities) are spatially separated. Similarly, all of the cetaceans found in Exmouth Gulf have a distribution range far greater than that of Exmouth Gulf therefore any potentially detrimental impacts are likely to be localised and not widespread.

And finally, while prawn trawlers have operated in Exmouth Gulf for over four decades the anecdotal evidence suggests that populations of dugongs and cetaceans have not changed significantly over that time.

5.2.2.2 Protected species – Leatherback turtles

Rationale for inclusion

Leatherback turtles are considered a protected species under Commonwealth legislation and are found in Exmouth Gulf.

ERA Risk Rating: Impact on breeding population (C0 L5 NEGLIGIBLE)

In terms of the impact of the EGP fishery on the leatherback turtle breeding population by way of interaction (as opposed to capture), the risk assessment determined that it was ‘likely’ that the Fishery would have a ‘negligible’ impact.

Exmouth Gulf is approaching the southern end of the distributional range of the leatherback turtle. Leatherback turtles are quite uncommon in Exmouth Gulf. There are no known breeding locations in Exmouth Gulf and it is assumed that nesting occurs in the Indonesian Archipelago.

Leatherback turtles feed primarily on jellyfish therefore they are likely to only occur in Exmouth Gulf following a jellyfish aggregation.

Regardless, at such relatively low vessel speeds (around 4 knots) it is highly unlikely that any leatherback turtle on the trawl ground would come in direct contact with a trawler or the gear being towed because they would be able to actively remove themselves from the path. Direct physical interactions are more likely to occur with fast moving recreational craft.

5.2.2.3 Threatened/listed species – Loggerhead turtles

Rationale for inclusion

Loggerhead turtles are considered an endangered species under Commonwealth legislation and are an inhabitant of Exmouth Gulf waters.

ERA Risk Rating: Impact on breeding populations (C1 L4 LOW)

In terms of the impact of the EGP fishery on the loggerhead turtle breeding population by way of interaction (as opposed to capture), the risk assessment determined that it was ‘likely’ that the Fishery would have a ‘negligible’ impact.

Loggerhead turtles are relatively less common than green turtles in Exmouth Gulf but have a wide distributional range. Loggerheads are generally found within shallow waters outside of the trawl grounds however they also forage over open substrate such as the mud/shell substrate that dominates the trawl grounds in Exmouth Gulf. Consequently, trawlers and green turtles may interact.

However, at such relatively low vessel speeds (around 4 knots) it is highly unlikely that any loggerhead turtle on the trawl ground would come in direct contact with a trawler or the gear being towed because

they would be able to actively remove themselves from the path. Direct physical interactions are more likely to occur with fast moving recreational craft.

5.2.2.4 Threatened/listed species – Green turtles

Rationale for inclusion

Green turtles are considered a vulnerable species under Commonwealth legislation and are an inhabitant of Exmouth Gulf waters.

ERA Risk Rating: Impact on breeding population (C0 L5 NEGLIGIBLE)

In terms of the impact of the EGP fishery on the green turtle breeding population by way of interaction (as opposed to capture), the risk assessment determined that it was ‘likely’ that the Fishery would have a ‘negligible’ impact. This is based on the knowledge that green turtles are by far the most abundant turtles in Exmouth Gulf and adult green turtles are herbivorous and therefore likely to forage in the shallow seagrass and macroalgal beds that are predominantly closed to trawling. Consequently, trawlers and green turtles are unlikely to interact.

Furthermore, at such relatively low vessel speeds (around 4 knots) it is highly unlikely that any green turtle traversing the trawl ground would come in direct contact with a trawler or the gear being towed because they would be able to actively remove themselves from the path. Direct physical interactions are more likely to occur with fast moving recreational craft.

5.2.2.5 Threatened/listed species – Flatback turtles

Rationale for inclusion

Flatback turtles are considered a vulnerable species under Commonwealth legislation and are found in Exmouth Gulf.

ERA Risk Rating: Impact on breeding population (C0 L5 NEGLIGIBLE)

In terms of the impact of the EGP fishery on the flatback turtle breeding population by way of interaction (as opposed to capture), the risk assessment determined that it was ‘likely’ that the Fishery would have a ‘negligible’ impact.

Given the preferred diet and foraging behaviour of flatback turtles it is likely that they may occur on the trawl grounds.

However, at such relatively low vessel speeds (around 4 knots) it is highly unlikely that any flatback turtle on the trawl ground would come in direct contact with a trawler or the gear being towed because they would be able to actively remove themselves from the path. Direct physical interactions are more likely to occur with fast moving recreational craft.

5.2.2.6 Threatened/listed species – Hawksbill turtles

Rationale for inclusion

Hawksbill turtles are considered a vulnerable species under Commonwealth legislation and are found in Exmouth Gulf.

ERA Risk Rating: Impact on breeding population (C0 L5 NEGLIGIBLE)

In terms of the impact of the EGP fishery on the hawksbill turtle breeding population by way of

interaction (as opposed to capture), the risk assessment determined that it was ‘likely’ that the Fishery would have a ‘negligible’ impact.

Exmouth Gulf is well within the distributional range of the hawksbill turtle however they are relatively uncommon. The hawksbill turtle prefers foraging over hard coral and rock substrate so it is unlikely to physically occur on the trawl grounds. The coralline and rock substrates are generally outside of the trawlable areas – however, trawlers actively avoid these areas anyway given the potential damage that can occur to the gear by hard bottoms.

Regardless, at such relatively low vessel speeds (around 4 knots) it is highly unlikely that any hawksbill turtle on the trawl ground would come in direct contact with a trawler or the gear being towed because they would be able to actively remove themselves from the path. Direct physical interactions are more likely to occur with fast moving recreational craft.

5.3 GENERAL ENVIRONMENT

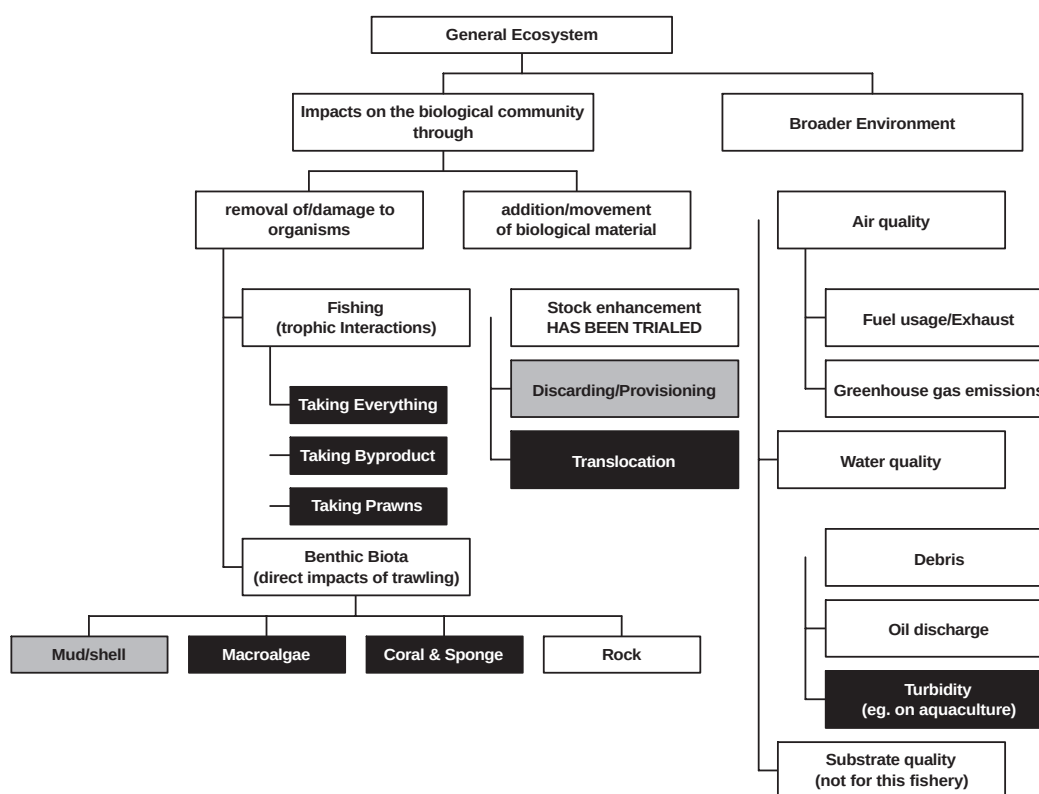


Figure 20. Component tree for the general environment.

Black boxes indicate that the issue was considered high enough risk at the June 2001 Risk Assessment workshop to warrant having a full reports on performance. Grey boxes indicate the issue was rated as a low risk and no specific management is required – only justification is presented.

5.3.1 Impacts from removal or damage to the environment

5.3.1.1 Prawns

Rationale for inclusion

The EGP fishery targets tiger, king, endeavour and occasionally banana prawns.

ERA Risk Rating: Impact on Trophic Structure (C1 L3 LOW)

The removal of target prawns from the Exmouth Gulf environment by way of trawling is considered ‘minor’ in terms of impact to the ecosystem as a whole. This conclusion is made on the following basis.

The fishing mortality rate of prawns in Exmouth Gulf is relatively low compared to the natural seasonal variability of prawn populations (as a consequence of environmental conditions such as water temperature, currents and natural events such as cyclones).

Furthermore, there are no known obligate prawn predators, which are likely to be directly impacted upon by the removal of adult sized prawns. Most carnivorous predators are opportunistic and/or scavengers and therefore are not considered dependent on any one species. Consequently, it is not likely that the commercial take of prawns impacts significantly on the trophic levels structure within the Exmouth Gulf ecosystem.

5.3.1.2 By-product species

Rationale for inclusion

The EGP fishery removes quantities of species other than the target prawns as by-product.

ERA Risk Rating: Impact on trophic structure (C0 L5 NEGLIGIBLE)

As noted above, there are no known breeding populations of by-product species that are significantly impacted upon by the trawling activities in Exmouth Gulf. The by-product species are taken in relatively small quantities and generally have large distribution ranges. In Exmouth Gulf specifically there are also a number of permanent closure areas that afford protection to proportions of populations.

As for the target prawns, the fishing mortality rate for by-product species in Exmouth Gulf is relatively low compared to the natural seasonal variability of populations (as a consequence of environmental conditions such as water temperature, currents and natural events such as cyclones).

Furthermore, there are no known obligate predators in Exmouth Gulf that are likely to be directly impacted upon by the removal of a particular species. Most carnivorous predators are opportunistic and/or scavengers and therefore are not considered dependent on any one species. Consequently, it is not likely that the commercial take of by-product species will impact significantly on the trophic levels structure within the Exmouth Gulf ecosystem.

5.3.1.3 All retained and non-retained species

Rationale for inclusion

In recent years, there has been growing concern about the potential impact that reducing the collective abundance of target and by-product species could have on the trophic associations. The risks associated with the potential impacts of the collective reduction of all retained and non-retained (the majority of which do not survive) species, in terms of trophic interactions therefore require consideration.

ERA Risk Rating: Impact on trophic structure (C2 L2 LOW)

The impact on the environment, by removing the sum of all retained and discarded species was considered to be unlikely to even cause a moderate change to the ecosystem hence it was only a minor risk on the Exmouth Gulf environment.

The information used to come to this conclusion includes:

- Prawns have a very high natural mortality rate such that a large percentage of the yearly recruits would already be removed from the system (either from death or predation) by the end of the season regardless of fishing. As a result of the natural variation of prawn populations being very high, the effect of removing prawns through fishing would be masked.
- The management arrangements of area and seasonal closures ensure that an adequate spawning stock of all species of prawns survive to reproduce recruits for the subsequent season.
- There are no known obligate prawn predators, which are likely to be directly impacted upon by the removal of adult-sized prawns. Most prawn predators are opportunistic and/or scavengers and therefore not dependent on any one species. A variety of other small crustacean, invertebrate and fish species live in these areas. Consequently, it is not likely that the commercial take of prawns significantly impacts on the upper trophic levels within the Exmouth Gulf ecosystem.
- The cumulative take of other by-product species is relatively low, ranging from 2 to 13 tonnes per season. The impact of the take of by-product species on the environment was considered to be 'negligible' as the amount of each by-product species, and the total by-product amount is insignificant and likely to be less than the natural background variation in abundance.
- Exmouth Gulf is considered to be a highly productive system and as such the removal of this level of biological material is not likely to be detectable.
- Trawling only occurs in a relatively small area of Exmouth Gulf (35%) and only for a period of 8 months (April to November). In addition, a four-day moon closure is in place over the full moon period for each fishing month.
- Although no specific research on this subject has been undertaken in Exmouth Gulf, several studies around the world have investigated this subject and found that:
- Following the review of ecosystems impacts of fishing, Jennings and Kaiser (1998) concluded from the current empirical evidence that it is wrong to assume that most predator-prey relationships are tightly coupled and the removal or proliferation of one species, which eats another will result in detectable changes in ecological processes.
- Greenstreet and Hall (1996) studied periods in the North Sea fishery that were 50 years apart and found little change in community structure of non-target species while the changes in target species were directly caused by fishing.
- Harris and Poiner (1991) examined changes in the tropical demersal fish community and after 30 years of prawn trawling in the Gulf of Carpentaria found the abundance of benthic associated species had decreased and semi-pelagic increased. Most changes occurred in target and bycatch taxa and there was little evidence of any indirect trophic related effects.

5.3.1.4 Impact to the mud/sand habitat

Rationale for inclusion

Prawn trawling in Exmouth Gulf occurs predominantly over mud and sand habitats. When trawling, ground chains and otter boards make contact with the sea bottom, disrupting organisms within the habitat. Evidence from video footage of trawled areas of Shark Bay suggests that trawling over sand has

the effect of flattening this otherwise rippled and three-dimensional substrate. This may also indirectly affect the species that inhabit this area by changing the nature of their habitat.

While mud/sand habitat structure and ecology were originally identified as separate issues, it is not possible to separate them in this assessment process because in real terms physical change to the bottom structure is largely irrelevant unless it impacts on the surrounding ecology.

ERA Risk Rating: Impact to habitat ecology and structure (C2 L2 LOW)

The potential impact on the mud and sand habitat on Exmouth Gulf, as a result of the prawn trawling operations was considered unlikely to have even a minor consequence (which provides a low risk) due to the following:

- Of the area that is permitted to be trawled, only around 35% of this is actually trawled (due to targeting of known favourable grounds).
- Furthermore, 28% of the area is permanently closed to trawling.
- Studies of actual impacts from prawn trawling suggest only minimal impacts to infaunal communities.

It should also be noted that the mud substrate in Exmouth Gulf is generally comprised of coarser and heavier sediments and is therefore thought to be more ‘resistant’ to disturbance by trawling activities. Moreover, such ‘exposed’ seabeds are naturally dynamic as a result of environmental influences.

Whilst the level of risk was considered LOW, the operations of the fishery need to be managed to keep it within these acceptable levels.

Operational objective

To maintain an acceptable level of impact on the mud/sand habitat in Exmouth Gulf.

Justification

Prawns are predominantly targeted over mud/sand substrate in Exmouth Gulf. Mud/shell habitat harbors many infaunal and epifaunal assemblages.

Indicator

The percentage of the mud/sand habitat of the Exmouth Gulf region that is trawled.

Performance measure

Area of mud/sand habitat available for trawling needs to be kept to no greater than 40% of the total mud/sand habitat in Exmouth Gulf.

Justification

The extensively trawled areas of Exmouth Gulf are estimated to be about 35% of the total waters in Exmouth Gulf (1475.5 km²). This is a relatively small percentage of the total area of bay and would provide a substantial amount of refuge even if the area trawled was extensively impacted.

However, it should be noted that there are a number of studies, which have shown that no significant effects to the infaunal community are caused in areas of similar habitat where trawling occurs. A meta-analysis of fishing impacts by Collie et al. (2000) found that otter trawling had the least impact of all forms of trawling. Specifically, Kaiser and Spencer (1996) found no detectable difference between

trawled and untrawled areas (beam trawl) within mobile sediment regions. Van Dolah et al. (1991) studied changes in infaunal communities over 5 months for areas closed to shrimp trawling. They concluded that the seasonal reductions in abundance and number of species sampled had a much greater effect than fishing. Finally, Jennings and Kaiser (1998) suggested that light shrimp trawls do not cause significant disturbance to communities in shallow water with poorly sorted sediments.

In Australia, Gibbs et al. (1980) found only minimal impacts on the benthic communities resulting from prawn trawling in Botany Bay. In southwest Western Australia, Laurenson et al. (1993) compared trawled and untrawled areas using trawl samples and underwater video. Their study concluded that the dominant fauna of each area showed marked similarities, although each group had a different group of less abundant species. The difference was attributed to the fact that the untrawled area was small and encroached in all directions by seagrass. Underwater video observation of both areas before and after the completion of the depletion experiment failed to detect any visual impact on the substrate or habitat. Extrapolating this study to Exmouth Gulf would indicate that trawling causes only minor and short-lived impact to mud/sand habitats.

Consequently, a performance measure of 40% is considered precautionary, while allowing for flexibility of the fleet for economic efficiency.

Data requirements for indicator

Data required would be:

- Knowledge of spatial distribution of trawled and untrawled areas.
- Knowledge of spatial distribution of mud/sand habitats within Exmouth Gulf region.

Data availability (past – current – future)

Knowledge of spatial distribution of trawled and untrawled areas.

Based on log book data a good record exists of the location of trawled and untrawled areas. The upcoming introduction of a VMS to this fishery will provide more accurate information of the physically trawled areas of Exmouth Gulf.

Knowledge of spatial distribution of mud/sand habitats within the Exmouth Gulf region.

The distribution of habitats within Exmouth Gulf is relatively well understood. This data exists in GIS format, largely generated by the Department of Conservation and Land Management.

Evaluation

Currently, trawling is estimated to occur over 35% of the mud/sand habitat within Exmouth Gulf.

Robustness

Robustness is considered relatively high given the long-term log book data available and the introduction of the VMS in 2002. Furthermore, the distribution of different types of habitats in Exmouth Gulf is relatively well understood.

Fisheries management response

Current: Trawling is only allowed within restricted areas to provide protection for sensitive nursery areas, which coincidentally also affords protection to other habitats including mud/sand habitats. In 2002, vessels will be required to have a VMS operating during the season that logs the positions of vessels to ensure that trawling does not occur outside permitted areas.

Future: Fishing effort and distribution will be monitored to ensure that no more than 40% of the total available mud/sand habitat is trawled.

Actions if Performance Limit is Exceeded: If monitoring reveals that greater than 40% of the mud/sand habitat is being trawled, the legal trawl boundaries will be amended to regulate for the 60% mud/sand refuge area. This action will be initiated within a season or prior to the beginning of the next season.

Comments and action

As the introduction of VMS occurs, the management of this issue will be refined.

External driver checklist

Natural events and prevailing environmental conditions also have the potential to impact the structure and ecology of mud/sand habitats in Exmouth Gulf. For example, the rainfall run-off generated by cyclones that frequent Exmouth Gulf has the potential to alter the bottom topography of substrates like mud/sand habitats. Similarly, wind generated water movements have the potential to change bottom features especially in relatively shallow waters. The ‘greenhouse effect’ may also impact on the structure and potentially the ecology of the mud/sand habitats in Exmouth Gulf in the long-term as global weather patterns change the prevailing oceanographic currents.

5.3.1.5 Impact to the coral/sponge habitat

Rationale for inclusion

Internationally there has been concern about the impact of trawling on hard coral habitats. Soft coral and sponge habitats are also important sites for marine species. They provide habitat for fish and invertebrates and are the feeding and recruitment sites for many species. By virtue of their shape and physical structure, these habitats are vulnerable to physical damage. Furthermore, due to generally slow growth rates of coral and sponge they are slow to recover.

ERA Risk Rating: Impact to habitat ecology and structure (C1 L5 LOW)

While Ningaloo Reef is the largest continuous reef area in Western Australia it does not extend into the trawl grounds of the EGP fishery (with the exception of some small coral outcrops surrounding islands in the northeast sector of the Fishery). Thus the Fishery has no impact on hard corals.

Consequently, the trawl grounds and the vulnerable coral and sponge habitats are largely separated on a geographical and depth basis (given that the target prawn species prefers mud substrate). Furthermore, it should be noted that it is not in the interests of industry to trawl over hard coral given the damage coral causes to the gear. Current estimates of the amount of soft coral and sponge habitat within Exmouth Gulf suggest that there are only relatively small amounts, particularly in the trawlable areas.

5.3.1.6 Impact to the macro-algal habitats

Rationale for inclusion

Macro-algal beds are a significant feature of Exmouth Gulf and are considered responsible for the comparatively high level of productivity despite an apparent lack of nutrient input.

ERA Risk Rating: Impact to habitat ecology and structure (C0 L5 NEGLIGIBLE)

It was considered highly ‘likely’ that the prawn trawling activities undertaken in Exmouth Gulf would only pose a ‘negligible’ risk in terms of damage to macro-algal habitats.

This conclusion is made on the basis that the macro-algal beds are geographically separated from the actual trawl grounds. The macro-algal beds are predominantly located in the southern reaches and on the periphery of Exmouth Gulf in the shallow subtidal and low intertidal limestone pavement regions. The majority of these areas are a permanent nursery closure where trawling does not occur.

5.3.2 Addition of materials to habitat

5.3.2.1 Discarding fish

Rationale for inclusion

Bycatch results in fish and, to a lesser extent crustaceans, being made available to other organisms that would normally not have access to such a food source. This has the potential to affect the feeding behaviour of some species, particularly predators, and alter the distribution of other species throughout the water column and at the surface. For example, dead fish that sink to the seafloor become available to benthic scavengers such as crabs. These fish would normally only be available, in that level of abundance, to pelagic predators.

Studies on the fate of discards through the trophic structure have not been undertaken in the EGP fishery, but it has been examined in other fisheries. For example:

- Britton and Morton (1994) reviewed the discard provisioning issue and found that discarding had a “positive” impact on bird population numbers as they can follow the North Sea fleet and consume 50% of the discards. Other benthic fauna can only get what actually falls down on to the seabed and only in the area where they reside (Ramsey et al., 1997). Hence, this study concluded that discarding would not have a major impact on immobile benthic species.
- In the Great Barrier Reef Trawl Fishery, a study showed that the majority of the discards were fish and about 40% floated. Most were taken in the daytime by birds, dolphins and sharks (Poiner et al., 1999). Poiner *et al.* 1999 concluded that because discards were dispersed over the seabed and most scavengers forage over a restricted area, discards probably did not cause a measurable impact to the seabed.
- In Moreton Bay, Queensland, Wassenburg & Hill (1987) found that crabs were a dominant scavenger of bycatch from the local prawn trawl fishery, with 30% of their diet coming from this source (note over 65% of the bycatch material from this fishery sinks). This study also found that trawl discards have become the principal food source for three species of seabirds (Wassenburg and Hill, 1990). It is also thought that larger populations of the blue swimmer crab (*Portunus pelagicus*) occur in Moreton Bay than would normally exist because of the food provided by trawler discards (Wassenburg and Hill, 1987).

Based on results from the observer program, in the EGP fishery the ratio of discards to retained species is about 2-5:1 (weight in terms of small fish, invertebrates and sponges). Of this, about 50% of the fish sink, and most is dead, therefore becoming available to bottom feeders. Most of the crustaceans sink but have a relatively high survival rate.

ERA Risk Rating: Impact on environment (C2 L3 LOW)

The impact of the provisioning bycatch discards from the EGP fishery was considered ‘unlikely’ to have a ‘moderate’ consequence. This results in an overall risk rating of low. This was a result of the following factors:

- Although many studies have shown that various trophic groups feed on bycatch, few studies have found direct conclusive evidence of a resultant change in trophic structure.
- In Exmouth Gulf, there is neither direct scientific evidence nor any anecdotal suggestion of changes to the food web from the removal of particular groups or species, or from food being cycled from the bottom of the sea floor to the surface.
- The area over which organisms are discarded is large and therefore any impacts would be diffused. The amount of discards is estimated to be approximately 2-5 times the target catch. Thus for 1998/99, the estimated discard amount is 3,000 tonnes (based on 3 times the target catch). Over the area of the functional Fishery, this would result in an average of 2 tonnes of discards per square kilometre, or 2000 grams per square metre. This amount of provisioning would occur once over the season of the Fishery and is considered very minor. To account for the fact that discards are not spread evenly, if some areas experience ten times this amount of provisioning, (that is, 2000g per square metre), the impact would still be considered relatively minor.
- The introduction of bycatch reduction devices in the Fishery will further reduce bycatch provisioning as the grids and secondary devices will reduce the overall amount of bycatch generated by the Fishery and hence a reduction in the amount of discards.

However, it should be noted that:

- Trawling is considered to provide some specific ‘benefit’ to some seabirds populations by aggregating food items normally at very low densities in the water column.
- It has been suggested that crested tern populations in Exmouth Gulf have increased in abundance as a result of discards from the Fishery (*Dr. N. Dunlop*, pers. comm.*).
- Increasing numbers of breeding terns can induce significant changes to the vegetation structure on small islands, often to the detriment of other wildlife (*Dr. N. Dunlop*, pers. comm.*).

It should also be noted that a reduction in overall bycatch through the introduction of bycatch reduction devices could have a negative impact on the abundance of some species, which have developed an association with discarded bycatch.

Operational objective

To minimise the level of discards, which in turn will minimise possible changes in trophic structure from provisioning.

Justification

The objective to manage the amount of discards was chosen over an objective relating to reducing the impact on the complex trophic interactions because the identified consequences were not considered major at current levels of discarding. Given this, it is considered that the most appropriate management objective would be to minimise the opportunity for this to occur, by reducing the amount of discards (through reducing the amount of bycatch in the first instance).

* Dr Nic Dunlop, Conservation Council of Western Australia.

Indicator

Amount of discards per season

The amount of discards per fishing season will be monitored as a measure of the performance against the objective.

Ratio of discards to target catch

Changes in the current range of bycatch to catch ratios (or ratios once full implementation of bycatch reduction devices is complete) may indicate either changes in the behaviour of fishermen in targeting prawns; abundance of bycatch species and/or prawns; or lack of quality control with respect to the functioning of bycatch reduction devices.

Performance measure

Reduction in the amount of discards from pre-introduction of bycatch reduction device levels. Reduction in the ratio of discards to target catch from levels obtained pre-introduction of bycatch reduction devices.

Justification

In the absence of empirical data on the impact of discard provisioning on the ecosystem, it is necessary that a precautionary approach be adopted. That is, that at the very minimum the level of discards does not increase beyond existing levels but ideally that the quantity of discards and/or the ratio of discards to target catch decreases.

Data requirements for indicator

Data required in order to measure this indicator are:

- *Amount of discards.* This would need to be gathered by Departmental observers on a five-year interval.
- *Ratio of target catches to discards.* To establish this data the amount of target catch would be required in addition to the amount of discards (as provided above).

Data availability

Amount of discards and ratio of target catches to discards

As a result of the observer program that has been conducted over the past two years in the EGP fishery, there is some data available on the amount and proportion of discards generated by the Fishery. A limited observer program continued following the full introduction of bycatch reduction devices in 2003.

In order to measure the performance of the Fishery in future years it will be necessary to undertake additional observer programs. It is intended to undertake a bycatch survey every five years in order to monitor the effectiveness of the bycatch reduction devices at reducing the overall amount of bycatch and hence discards.

The amount of target species caught is already recorded as part of the standard monthly catch returns administered by the Research Division.

Evaluation

It is expected that the overall amount of bycatch and hence discards will decrease once grids and secondary devices (i.e. square meshes) are introduced to the Fishery in 2002 and 2003, respectively.

Robustness

The amount of discards will be based on research data collected every five years. As this will be done every five years the accuracy is expected to be low to medium.

Fisheries management response

Current: In the 2002 fishing season, trawlers were required to fish with one BRD. This first season with BRDs in the fleet allowed for the Department of Fisheries to ensure catch efficiency indices to be recalibrated. In the 2003 season, 100% bycatch reduction device (one BRDs in each net) were introduced. This staggered introduction is expected to reduce discards to a level that can be considered 'best practice' and which will set the future maximum allowable discard level.

Future: It is expected that new and improved designs of grids and secondary devices will be developed in the coming years. The Department of Fisheries encourages the development of gear that is capable of further reducing bycatch as well as optimising efficiency.

Actions if Performance Limit is Exceeded: In the event that the amount of discards increases, a report will be commissioned to investigate and document the reasons for the increase. If the reasons for the increase in discards require management intervention, the following options will be investigated:

- reducing bycatch through spatial or temporal closures;
- further technical improvements to bycatch reduction devices to reduce bycatch; and
- introduction of other effort restrictions to reduce the overall level of bycatch.

These actions can be initiated within a season or prior to the beginning of the next season.

Comments and action

Summary of Actions

- Introduce 100% bycatch reduction devices in 2003.
- Department of Fisheries Research Division to monitor amount of discards and proportion of bycatch on a five-year basis.

External driver checklist

None.

5.3.3 General impacts on the environment

5.3.3.1 Creation of turbidity from trawling

Rationale for inclusion

The interaction between trawl gear and the seabottom has the potential to raise sediments into the water column, resulting in increased turbidity. If turbidity resulting from trawling activities was above the natural turbidity range (in terms of either intensity or duration) then there could be implications for the local communities through reduction of light availability for seagrass productivity and/or smothering of benthic organisms such as corals and sponges.

ERA Risk Rating: Impact on environment (C0 L5 NEGLIGIBLE)

The prawn trawling activities undertaken in the waters of Exmouth Gulf are considered ‘negligible’ in terms of creating a more turbid environment (which has the potential to increase the nutrient loading of the ecosystem and cause habitat siltation).

This conclusion is made on the basis that the trawl gear design is such that it is not in direct and consistent contact with the substrate and therefore does not disturb the substrate to any significant degree; and that the ground trawled in Exmouth Gulf is typically comprised of coarse sediments that do not readily ‘silt’.

Furthermore, it should be noted that Exmouth Gulf is a cyclone ‘hotspot’ and is influenced on a regular basis by either direct cyclonic ‘hits’ or indirectly through swell and wind emanating from other cyclone centres. Consequently, while prawn trawling is not thought to contribute significantly to the level of turbidity in Exmouth Gulf, Exmouth Gulf itself is regularly ‘clouded’ as a result of acute environmental events. The ‘recovery’ time of Exmouth Gulf following such a cyclonic event is generally dependent on the intensity, duration and rainfall associated with that event.

5.3.3.2 Translocation

Rationale for inclusion

The movement of fishing vessels provides a mechanism for marine species to be transported beyond their natural range. In extreme circumstances, fishing vessels could provide a vector for disease and exotic species. With respect to Exmouth Gulf prawn trawl vessels the opportunity for this is provided primarily by hull fouling, as the vessels do not carry ballast water.

ERA Risk Rating: Impact on the environment (C0 L5 NEGLIGIBLE)

This risk of translocation of species occurring as a result of this Fishery was considered ‘likely’ to be ‘negligible’ as vessels in Exmouth Gulf have little interaction with fisheries in other regions and although some vessels have licences to operate in the Onlsow and Kimberley fisheries, these are generally not utilised.

Vessels often move to Fremantle for seasonal maintenance (generally over the summer months). The only known exotic species in the Fremantle area is *Sabella* spp., which is a temperate species and is unlikely to survive if transported to the tropical waters of the Gascoyne on trawl vessel hulls.

Furthermore, any species present in Exmouth Gulf may find its way south in years when the Leeuwin current is strong anyway. However, it is highly unlikely that any such transported species would survive long term given the large seasonal variations in water temperature between the north and south of the State.

5.4 GOVERNANCE

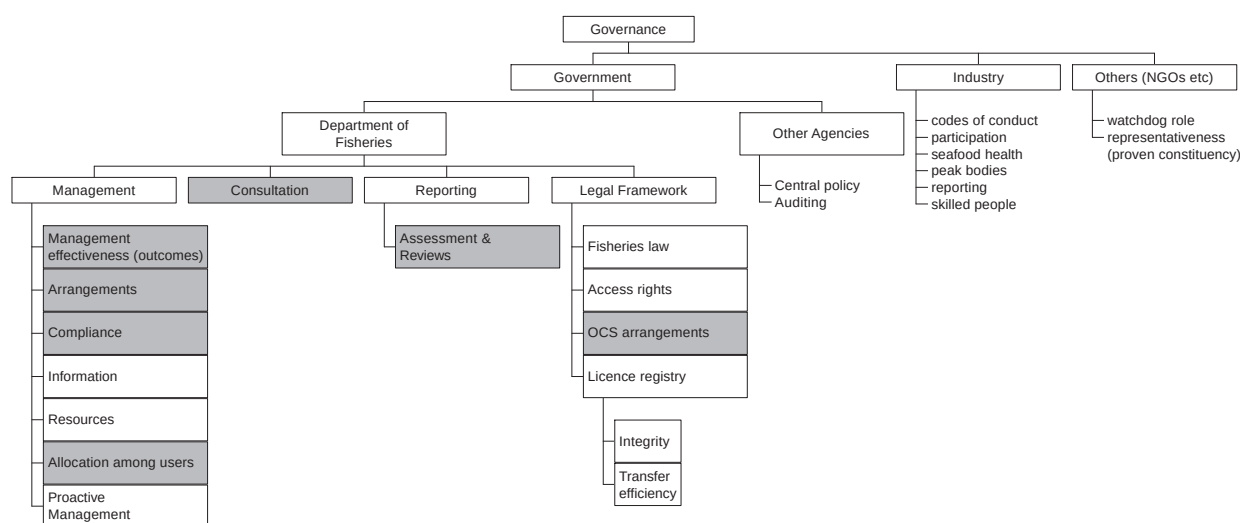


Figure 21. Component tree for governance of the EGP fishery.

Whilst no generic components have been removed from the tree only those boxes that are grey will be reported in this report.

5.4.1 Department of Fisheries – Management

5.4.1.1 Management effectiveness (outcomes)

Rationale for inclusion

The effectiveness of management activities (e.g. spatial and temporal closures, limited entry, gear controls) should ultimately be reflected by the extent to which the fishery continues to produce expected outcomes (maintaining the catch of prawns at acceptable levels). In Sections 5.1.1.1 – 5.1.1.4, the catches for the individual prawn species were discussed and analysed, therefore this section will look at the cumulative catch and assess whether current management arrangements are maintaining the total catch for all prawn species within an acceptable range. Thus, if the annual acceptable catch range of prawns is maintained then the community’s expectation that variations in annual catch result only from annual changes in environmental conditions, or planned changes to the management of the level of commercial exploitation and not from stock depletion will be continued. Any large unexplained variation in catch, particularly any significant and unexplainable reduction in catch, is likely to be a reflection of a reduction in the management effectiveness. This would reduce the community’s confidence in the management of the resource and raise concerns about the ongoing sustainability of the fishery.

Operational objective

The commercial catch of all prawns is maintained within an acceptable range on an annual basis.

Justification

If all management arrangements developed for this fishery, including the restrictions on effective effort levels, compliance with the regulations is being maintained effectively, combined with our understanding of the size of the exploitable stock - then the total catch (for king, tiger, endeavour and banana prawns) should be within the historical acceptable range. Any variation outside this range would elicit the need to at least explain the cause of this deviation.

Indicator

The total catch compared to historical acceptable range for all four penaeid prawns in the EGP fishery.

Performance measure

Under current fishing effort levels, the catch projections for this fishery are that the total catch of penaeids should be within the range of 771-1,276 t.

Justification

The justification for the individual levels for each penaeid species is located in Section 5.1.

Data requirements for indicator

The following data is required for this indicator:

Data Requirement	Data Availability
Commercial catch and effort.	Yes – obtained annually.
Historical catch levels.	Yes – records available and accessible.
Level of fishing effort and fishing power.	Yes – number of vessels, days fished, hours trawled, areas of operation and activity and fishing power comparisons readily available.
Environmental indicators.	Yes – key environmental indicators readily available.

Evaluation

Summary: Historical catch and effort information indicate that production levels for this fishery have been relatively stable over the past 5 years. The catch has generally been within the agreed reference range. Therefore, the performance measure has not been triggered and current management strategies appear to be effective in achieving the overall objectives for the fishery.

The total catch of penaeids by the EGP fishery was 1,467 t in 1999, which is just above the acceptable catch range (Table 7). The higher catch was a result of an unusually large catch of endeavour prawns in this year, which was caused by the unusual and strong impacts of Cyclone Vance on the Exmouth Gulf region. This was reflected in the 2000 catch, which was down with 565 tonnes of prawns caught in total. This was below the acceptable catch range due to the negative impacts of Cyclone Vance.

Table 5. The total catch of penaeids in the EGP fishery.

Year	Total Catch of Penaeids (t)
1990	1,149
1991	958
1992	1,036
1993	1,020
1994	1,276
1995	1192
1996	771
1997	815
1998	1,058
1999	1,467
2000	565

Robustness

Medium/High

The data required for the indicator is, in most cases, readily available. The changes in fishing power and fleet efficiency through time need to be evaluated and considered in these analyses to ensure that the measures continue to be relevant.

Fisheries management response

Current: The management measures imposed to achieve the objective for the spawning stock and total catch (see above) also serve to achieve the objective related to the exploitable stock.

Historically, variations in catch outside of the range expected have been explained either in terms of increased fishing effort, increased fishing efficiency or seasonal environmental factors. The response to this has been to reduce fishing effort (e.g. spatial or temporal closures) or to develop the predictive model to take account of environmental factors such as sea surface temperature and ENSO and El Niño events.

Future: The Department of Fisheries is doing further work to both improve the measurement of fishing efficiency and understanding the relationship between environmental factors and catch. The Department of Fisheries will continue to use input controls to adjust for variations in fishing efficiency.

Actions if Performance Limit is Exceeded: If the catch is outside of the range of expected values then a review of the causes would be undertaken prior to the beginning of the next season. This review would examine why the acceptable catch range was not met. If this variation is not explained by effort reductions or abnormal environmental variations then strategies that offer further protection to the breeding stock will be implemented for the following season. These strategies could include:

- Further reductions in the total effort expended in the fishery through a reduction in the length of the fishing season or within season closures, and/or extension of moon closures.
- Additional area closures.
- These actions can be initiated within a season or prior to the beginning of the next season.

Comments and action

While the Department has been able to maintain the catch of tiger, king, coral and endeavour prawns within acceptable levels, it continues to work on improving and refining the methods used to determine breeding stock estimates. The use of GIS systems for analysing data has commenced.

External driver checklist

Environmental factors such as: climatic changes, cyclonic activity impacting habitat, ocean currents and sea-surface temperatures are known to impact upon recruitment and therefore are likely to impact the catch of prawns. In Exmouth Gulf, the most significant risk factors are cyclonic activity and significant environmental pollution or habitat degradation.

5.4.1.2 Management arrangements

Rationale for inclusion

In Western Australia, a number of instruments are used to articulate the management arrangements for fisheries. The FRMA has elements that affect all fisheries in addition to this there are Management Plans, Orders, Regulations, Ministerial Guidelines and Policy Statements. In cases where current management arrangements were developed under the previous Act (as was the case for the EGP), whilst the terminology is different (see Table 6 for details), the powers from the old Act have been transferred under various sections of the Transitional Provisions of the FRMA (**S 266** Savings and transitional provisions - Schedule 3 parts 8-12, 15-19).

The EGP Plan, which, in effect, is a set of rules as to how the fishery will operate, obtains its authority from the FRMA and, in conjunction with the *Fish Resources Management Regulations, 1995* (FRMR) and any relevant Ministerial Policy Guidelines, is the vehicle through which the fishery is managed. The EGP Plan and the associated documentation (which includes the ESD report) should include all information expected to be in a “Best Practice” set of management arrangements (as defined in the Department’s ESD Policy - Fletcher 2002).

These arrangements should contain:

1. An explicit description of the management unit.
2. The issues addressed by the plan including criteria to operate in the fishery, the manner of fishing, the fishing season, fishing zones, licence renewals, transfers and cancellations, fishers offences and major provisions and process for amending the plan.
3. Descriptions of the stocks, their habitat and the fishing activities.
4. Clear operational (measurable) objectives and their associated performance measures and indicators.
5. Clearly defined rules, including what actions are to be taken if performance measures are triggered.
6. Economic and social characteristics of the groups involved in the fishery
7. Management and regulatory details for the implementation of the actual management plan.
8. The reporting and assessment arrangements.
9. How and when reviews of the plan will occur (including consultation mechanisms).
10. A synopsis of how each of the ESD issues is being addressed.

In the future, Ministerial Policy Guidelines will be developed to incorporate the ESD report, including all performance measures, responses and information requirements within one year and will include a clear timeframe for implementation. These guidelines will also include timeframes for all management responses and set out procedures to enable the amendment of management arrangements to respond to new information. All changes to the management plan or arrangements will be reported to DEH.

Guidelines will also be developed to address permitted byproducts with a robust system developed to add or remove species as appropriate. Suitable catch triggers will be developed to ensure any changes in targeting behaviour can be determined and be addressed within clear timeframes. These guidelines will include mechanisms for any cross-jurisdictional activities regarding relevant target and byproduct species, including squid.

Table 6. Comparison of terminology.

Old Act	New Act (FRMA 1994)
Limited Entry Fishery	Managed Fishery
Notice	Order
Arrangement	Arrangement

Operational objective

The Department of Fisheries, in consultation with the EGPMAC and other stakeholders, maintains a watch brief on the management plan, related legislation, regulations and arrangements to ensure it remains relevant and aligned with the fishery's management objectives and that collectively they cover the 10 main principles.

Justification

To have an effective and understandable plan for the management of this fishery with all of the 10 principles covered within the suite of arrangements developed for the fishery.

Indicator

The extent to which the management plan and supporting documentation addresses each of the issues and has appropriate objectives, indicators and performance measures, along with the planned management responses.

Performance measure

This should be 100%.

Evaluation

As an over-arching sub-component the performance of the management arrangements is evaluated on two levels – the micro level, i.e. the relevance of individual clauses and the role they play and on the macro level, i.e. the relevance of the plan as a whole and the role that it plays.

Current Performance against each of the areas required within the “plan”⁴:

1. **An explicit description of the management unit** – The management unit is explicitly described within the “Declaration of the Fishery” section of the EGP Plan.

⁴ “Plan” – includes all management arrangements.

2. **The issues addressed by the plan** – The issues that need to be addressed by the EGP plan and are documented within the 8 ESD component trees and their reports.
3. **Descriptions of the stocks, their habitat and the fishing activities** – the EGP stock is well described in Section 2.1 and the fishing activities are described in Section 2.2.
4. **Clear operational (measurable) objectives and their associated performance measures and indicators** – These are located in Section 5 for each of the major issues.
5. **Clearly defined rules, including what actions are to be taken if performance measures are triggered** – For each of these major issues, the management actions that are planned to be taken if performance limits were exceeded are articulated in Section 5.
6. **Economic and social characteristics of the groups involved in the fishery** – A brief articulation of the economic and social characteristics is located in Section 3.3 and there is to be a greater level of detail accumulated during the process of completing the remainder of the ESD components.
7. **Management and regulatory details for the implementation of the actual management plan** – The regulations relating to the EGP fishery are located in both the EGP Plan and the FRMR and orders (A set of which has been provided to EA).
8. **The reporting and assessment arrangements** – These arrangements are documented in Section 5.4.4.1 and include annual reporting against current agreed performance limits and targets and a five yearly review of these arrangements and assumptions.
9. **How and when reviews of the plan will occur (including consultation mechanisms).** – A watching brief is maintained by the Department of Fisheries and EGPMAC on the functionality of the management arrangements. The FRMA clearly sets out how the process for the review of any management plan must occur.
10. **A synopsis of how each of the ESD issues is being addressed** – A synopsis of ESD issues has been compiled within the Overview Table of this report.

Robustness

High

The management plan and related legislation represent a comprehensive set of fisheries management legislation that is performing well. The fact that the management arrangements are contained within legislation provides a high degree of stability with respect to how the fishery is managed. This said, the processes for achieving management plan changes are well understood by the majority of stakeholders and the system is flexible enough for the management process to respond to change stimuli.

Fisheries management response

Management has successfully administered the management plan and related legislation to achieve and pursue the broad objectives of the FRMA.

Comments and action

As a result of 15 of the 16 licences being held by one operator, the management of this fishery is very different from other trawl fisheries such as Shark Bay Prawn Managed Fishery. The fishery is managed in a more corporate style. The meetings held between the Department of Fisheries and the two licence holders are more discussions and debates in a one on one forum instead of a consultative and dynamic forum where a variety of different, individual fishers are present and portray their views.

The commercial success of the fishery also appears to have encouraged the licence holders to be somewhat risk averse and inclined to a very conservative approach to managing the fishery (particularly given their level of investment). While this encourages an attitude of avoiding risks to the sustainability of the fishery, it can also sometimes make the licence holders resistant to changes in fishing rules that are designed to ensure sustainability. There is also sometimes a failure to recognise that the success of the fishery is in part due to a history of adaptive management. Proposed changes are often questioned on the basis that: “ as the fishery is operating successfully why, should any changes be necessary or contemplated?”

External driver checklist

- Resistance of fishers to change.
- Reluctance of Minister or Executive Director to exercise power.

5.4.1.3 Compliance

Rationale for inclusion

Effective compliance is vital to achieve the successful implementation of the management arrangements of any fishery. This involves a mix of sea and land patrols, radar watches, aerial surveillance and commencing in 2002 the VMS.

Operational objective

To have sufficiently high levels of compliance, which give confidence that the management arrangements are being effective.

Justification

The activities of the participants in the fishery need to be sufficiently consistent with the management framework and legislation to make it likely that the expected outcomes and objectives of the fishery will be achieved.

Indicators

The levels of compliance with the legislation, including the estimated level of illegal landings.

Degree of understanding of rules governing operation of the fishery by licensees and the broader fishing community.

Performance measure

Currently, the performance measures are under development but given the structure of this fishery the measures will be developed sensibly and include all players.

Data collection requirements and processes

- Random Inspections of Vessels at sea and port.
- Ongoing collection of data on illegal activities.
- Comparative data on the relative effectiveness of certain compliance techniques.
- VMS and other vessel surveillance data.

Evaluation

In the 2000 fishing season, the EGP fishery fleet did not receive any offences or infringements. Thus, current compliance techniques used in the EGP fishery are maintaining compliance by the fishers. Sea patrols and radar watches are conducted on a random basis during the season. Aerial compliance checks are also conducted throughout the season. Compliance operations are mainly focused on maintaining the integrity of the nursery areas within the Fishery. The compliance staff also conducts licence and gear inspections both at sea and port.

With the introduction of VMS to this Fishery in 2002, it is expected that random patrol activities will decrease overtime while targeted patrols investigating specific incidences will become the major focus of patrol activities.

Currently, a FRDC project is underway to examine compliance in the Western Rock Lobster fishery. This project aims to develop data collection, analysis and reporting protocols for all Western Australian recreational and commercial fisheries.

Robustness

Medium

The difficulties in identifying all types of illegal activities will remain.

Fisheries management response

The Regional Services Division of the Department continues to gather intelligence on suspected and known illegal activity within the fishery and does so by using state of the art technology and sound procedures.

Comments and action

The Department will continue to provide high standard compliance service to the EGP fishery. In 2002, the VMS will be introduced into this fishery and will enable the Department of Fisheries to monitor a vessel's location, speed and direction. This allows for particular attention to be paid to the surveillance of nursery areas. The Department of Fisheries works closely with the two operators and it's in their interest to comply. As a result, there is relatively low risk of non-compliance within this fishery due to the number of operators and the working relationship that has been established between the Department of Fisheries and the operators.

External driver checklist

Changes to technology that may facilitate an increase in the level of non-compliance.

5.4.1.4 Allocation among users

There is no recreational component to this fishery.

5.4.2 Department of Fisheries – Legal arrangements

5.4.2.1 OCS arrangements

The Offshore Constitutional Settlement (OCS) arrangements do not apply because the licenced fishery area for the EGP fishery is entirely within State waters.

5.4.3 Department of Fisheries – Consultation

5.4.3.1 Consultation

Rationale for inclusion

The FRMA has certain requirements with regard to consultation that must be undertaken in the course of managing fisheries. The management of the prawn fishery is based around a very extensive consultation and communication process.

There are sections in the FRMA that relate to the development of a management plan (Section 64) and to the amendment of a management plan (Section 65). Given that the EGP already has a management plan, Section 65 is the most relevant.

This states that:

S 65. Procedure before amending management plan

1. *A management plan must specify an advisory committee or advisory committees or a person or persons who are to be consulted before the plan is amended or revoked.*
2. *Before amending or revoking a management plan the Minister must consult with the advisory committee or advisory committees or the person or persons specified for that purpose in the plan.*
3. *Despite subsection (2), the Minister may amend a management plan without consulting in accordance with that subsection if, in the Minister's opinion, the amendment is –*
 - (a) *required urgently; or*
 - (b) *of a minor nature*
4. *If –*
 - (a) *the Minister amends a management plan; and*
 - (b) *the amendment is made without consultation because it is, in the Minister's opinion , required urgently,**the Minister must consult with the advisory committee or advisory committees or the person or persons specified for that purpose in the plan as soon as practicable after the plan has been amended.*

In addition, under clause 9 of the Management Plan, the Executive Director (ED) can only make decisions after consultation with the licence holders.

The particular committee, which must be consulted for the EGP fishery is designated in the management plan as the EGPMAC. Section 41 gives the Minister the power to formulate a committee and create an instrument, which is gazetted to establish a committee.

In the future, opportunity will be provided to conservation, community and recreational fishing interests to participate in the processes of the main advisory body to the WA Fisheries minister for this fishery. Any relevant indigenous interests will also be considered through appropriate consultative mechanisms.

Operational objective

To administer a consultation process that is in accordance with the requirements of the FRMA and Management Plan, allowing for the best possible advice from all relevant stakeholders to be provided to the decision maker (Minister/ED) in a timely manner.

Indicators

- The Minister or ED (or the Department on their behalf) conforms to the consultation requirements of the FRMA and Management Plan.
- The level to which licencees consider that they are adequately and appropriately consulted.

Performance measures

Advice provided to the Minister following each EGPMAC meeting.

Proper consultation procedures have been followed in any amendment of the management plan.

License holders and skippers meetings held annually.

Data requirements

Views on the EGPMAC and related consultation processes collected from stakeholders at each annual meeting.

Documentation of the formal consultation procedures followed when an amendment is made.

Evaluation

Consultation on management of the prawn fishery is conducted in an open, accountable and inclusive environment where all sectors of the industry and the Department's managers and researchers collectively identify and discuss appropriate courses of action.

Decision makers take due notice of advice provided on the basis of this consultation and give reasons for any decisions, which vary from consultation-based advice.

Robustness

High

The consultation process is extremely well understood with relatively high levels of participation from the various stakeholder groups.

Fisheries management response

The Department has strong links to the trawl industry through a formal statutory process. Under Section 41(2) of the FRMA the EGPMAC has the function to *“provide information and advice to the Minister on matters related to the protection and management of the fishery”*.

Membership of the EGPMAC comprises; an independent Chairperson; Executive Director the Department of Fisheries; an officer from the Department; and commercial prawn fishers. Terms of appointment are usually for two years however members can seek to be reappointed for additional terms.

EGPMAC has a number of sub-committees, which are chaired by EGPMAC members but nominations are sought from industry groups to make up the sub-committees.

The Department does, however, also provide independent advice to the Minister on the implications of any proposal from EGPMAC, or other body.

Comments and action

The Department will continue to maintain a consultation body (such as the EGPMAC) for the EGP industry.

External driver checklist

Despite the robustness of the EGPMAC and other consultation processes used, disaffected parties may still seek to use political avenues to further their cause.

5.4.4 Department of Fisheries – Reporting

5.4.4.1 Assessments and reviews

Rationale for inclusion

It is important that the outcomes of the fisheries management processes administered by the Department for the EGP fishery are available for review by external parties. It is also important that the community is sufficiently informed on the status of this fishery, given that it is utilising a community resource. The reports that are currently provided annually are: the State of the Fisheries Report, the Annual report to the Auditor General; more irregular reports include the ESD report and an application to EA. There is a longer-term plan to have the entire system of management audited by the WA EPA.

Operational objective

Current: To report annually to the Parliament and community on the status of the fishery

Future: To develop an independent audit process for the fishery at appropriate intervals. To develop a process where all protected species interactions by commercial operations should be reported and coupled with an education program to ensure industry has the ability to make accurate reports.

Indicators

- The extent to which external bodies with knowledge on the management of fisheries resources have access to relevant material.
- Level of acceptance within the community.

Performance measure

General acceptance of the management system by the community.

Data requirements

The majority of data required to generate reports is already collected in the course of pursuing resource management objectives. The Department conducts an annual survey of the community with respect to its opinion on the status of the State's fisheries and their attitudes to the performance of the Department.

Evaluation

The Department has implemented more than one process to report on the performance of this fishery and in doing so has ensured that the community has access to this information.

In addition to this base level reporting the development of a new process that will see the fishery undergo regular independent audits ensures this sub-component is well in hand.

The Department has been the recipient of a number of awards for excellence for its standard of reporting - Premiers Awards in 1998, 1999 for Public Service excellence, Category Awards in Annual Reporting in 1998, 1999, 2000; Lonnie Awards in 2000, 2001.

Current Reporting Arrangements for this fishery include:

State of Fisheries

The performance of the fishery is reported annually against the agreed objectives in the STATE OF THE FISHERIES REPORT. This document is available in hard copy format but is also available from the Department's web site in PDF format.

Annual Report

A summary of this report is presented within the Department's Annual Report and is used in some of the Performance Indicators that are reviewed annually by the OAG used to generate these reports.

ESD

This ESD Report (of which the material in the application was a subset), not only covers the environmental aspects of the fishery but the full social and economic issues. It is now available from the website.

Reports to Industry

Each year, the status of the resource, effectiveness of current management and any proposals for alterations to arrangements are presented to license holders and skippers. This includes the production of a summary report, which is provided to the audience.

Robustness

High

Fisheries management response

Current: For many years the Department has produced substantial and high quality documents that report on the operation of the Department and the status of its fisheries (including the EGP fishery) – these reports are the Annual Report and the State of the Fisheries.

Future: In line with the new Commonwealth Government requirements the Department of Fisheries is in the process of developing a tri-partite memorandum with the Western Australian Environmental Protection Authority and the Office of the Auditor General to conduct a regular audit of the fishery.

Comments and action

The processes already established and those new external review processes that are all but established ensure that there will be many opportunities for appropriateness of the management regime and importantly for the results it produces to be reviewed.

External Driver Check List

The assessments provided by independent review bodies and the community.

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7.0 Appendices

APPENDIX 1. TERMINOLOGY

Terminology for trawl gear

Booms	Steel structures to support trawl gear, outboard of the boats centre line.
Bridles Wire	Rope connecting otter boards to towing warp. The bridle length in this fishery is 25 to 30 fathoms.
Codend	Netting connected to the end of the trawl net to gather the accumulated catch during each tow. The end of the bag can be opened by releasing a drawstring and then the contents can be emptied onto the boats sorting table.
Drop chain	Length of chain (approximately 150mm) connecting footline to ground chain at about 1m intervals. This results in a gap between the footline and the ground chain that allows benthic objects to pass beneath the trawl net.
Footline	Lower frame line to which netting is attached in a trawl.
Ground chain	The chain is of similar length to the footline and travels across the seabed. Prawns and scallops react to the oncoming chain by rising from the substrate and into the net over the footline.
Headline	Upper frame line to which netting is attached in a trawl.
Lazy line	Rope connected to the codend to allow it to be hauled onboard the boat.
Lead-ahead	Where the headline is forward of the footline to form a verandah of netting to prevent prawns from escaping over the head line when they are disturbed by the ground chain.
Net	On a trawl, consists of netting hung between two frame lines. The lower frame line includes the ground chain that is connected by drop chains. Mesh size permitted in this fishery is no greater than 60mm.
Otter board	A solid device set at an angle of attack to the tow direction to generate a lateral hydrodynamic force to spread or open the net or trawl system.
Spread	Is the lateral distance that the headline is opened while the gear is working. Spread is expressed as a percentage of headline length and is called spread ratio.
Warp	Main towing wire from booms to bridle.

APPENDIX 2. FIGURES

A2.1 Landings (kgs) of by-product species by the egp fishery, 1980–2000.

* data incomplete

Year	Coral prawn	Squid	Cuttlefish	Octopus	Crab	Mackerel	Bonito	Tuna	Bugs	Cod	Shark	Cobia	NW Snapper	Pink Snapper
1980	-	3218	16	-	-	-	-	-	85	36	37	19	-	-
1981	-	2072	-	-	-	-	-	-	30	-	78	-	-	-
1982	-	1403	-	50	-	-	-	-	48	-	467	-	-	-
1983	-	1018	145	-	-	-	-	-	105	-	-	-	-	-
1984	-	998	318	-	-	40	-	80	-	-	547	-	-	-
1985	-	1776	712	137	-	-	-	-	15	-	843	-	45	-
1986	-	1685	420	257	-	-	-	-	-	-	1090	-	-	-
1987	-	2866	2581	587	-	-	-	-	40	203	1302	-	-	-
1988	-	5735	802	577	6130	301	204	136	136	356	4255	149	686	-
1989	64108	18631	1152	269	6068	912	7	75	415	1119	3593	345	681	161
1990	28913	6391	515	211	13726	87	-	-	594	165	3722	64	468	131
1991	44957	14826	930	640	11274	165	63	822	238	199	3099	135	1339	9
1992	74170	16791	1790	685	10574	283	-	208	291	32	2013	125	-	-
1993	115950	16292	963	248	7005	676	79	31	94	11	1884	263	-	-
1994	16292	10472	2305	227	34052	289	-	9422	107	110	7393	402	79	91
1995	84883	19555	782	435	1714	559	-	69	107	25	4014	466	9	23
1996	86892	11911	879	293	18525	910	2	4729	1315	71	13663	886	72	241
1997	59637	11619	484	654	20943	1114	-	197	332	13	7140	165	-	179
1998	40678	12379	1656	671	31995	512	-	-	33	-	4688	395	-	287
1999	19798	15877	273		42928	473			245	3552		302	146	
2000*	58996	9286	1962	291	5955	287			642		4127	272		

APPENDIX 3. ATTENDEES LISTS

A3.1 Workshop 1

Attendees:

Bill Aird, Denham RFAC
David Adams, Exmouth RFAC
Emma Hopkins, Department of Environmental Protection
Felix Correia, Correia Holdings Pty Ltd.
Fred Wells, Snr Curator WA Museum
Heidi Grief, Department of Fisheries
Graeme Stewart, Industry – Shark Bay Prawn
Guy Leyland, WAFIC
Hamish Ch'ng, Industry Shark Bay Scallop
Jim Penn, Department of Fisheries
Jo Bunting, Department of Fisheries
Keith Shadbolt, Denham RFAC
Kerry Truelove, EA
Lindsay Joll, Department of Fisheries
Malcolm McGowan, Industry – Shark Bay Scallop
Mark Flanigan, EA
Martin Holtz, Recfishwest
Mervi Kangas, Department of Fisheries
Nic Dunlop, Conservation Council of WA
Nick D'Adamo, CALM
Paul Bowers, Aboriginal Lands Trust
Phil Unsworth, Department of Fisheries
Prof. Di Walker, University of Western Australia
Richard Patty, Norwest Seafood
Rick Fletcher, Department of Fisheries
Rod Berg, Office of the Auditor General
Stephen Hood, Industry – Exmouth Gulf Prawn

A3.2 Workshop 2

Attendees:

Bill Aird, Denham RFAC
Bob Hoult, Denham
David Adams, Exmouth RFAC
Errol Sporer, Department of Fisheries
Felix Correia, Correia Holdings Pty Ltd.
Heidi Grief, Department of Fisheries
Hamish Ch'ng, Industry Shark Bay Scallop
Jenny Shaw, Department of Fisheries
Jim Penn, Department of Fisheries
Jo Bunting, Department of Fisheries
Keith Shadbolt, Denham RFAC
Les Moss, Shire of Shark Bay
Lindsay Joll, Department of Fisheries
Mark Hook, Shire of Shark Bay
Martin Holtz, Recfishwest
Mervi Kangas, Department of Fisheries
Nic Dunlop, Conservation Council of WA
Paul Bowers, Aboriginal Lands Trust
Prof Di Walker, University of Western Australia
Richard Patty, Norwest Seafood
Rick Fletcher, Department of Fisheries
Robert Prince, CALM
Rod Berg, Office of the Auditor General
Shane O'Donoghue, Department of Fisheries
Stephen Hood, Industry – Exmouth Gulf Prawn

APPENDIX 4. NATIONAL ESD CONSEQUENCE LEVELS AND LIKELIHOOD DEFINITIONS FOR RISK ASSESSMENT

Scope

- Retained/Non Retained/Protected species – assessed at level of locally reproducing population –unit stock
- Ecosystem – indirect impacts due to flow on effects on food chain assessed at the Regional/ Bioregional level
- Habitat (attached species – e.g. seagrass) assessed at the regional habitat level defined as the entire habitat equivalent to that occupied by the exploited stock.

A4.1 Table – Risk Matrix

		Consequence					
Likelihood		Negligible	Minor	Moderate	Severe	Major	Catastrophic
		0	1	2	3	4	5
Remote	1	0	1	1	1	1	1
Rare	2	0	1	1	1	2	2
Unlikely	3	0	1	1	2	2	3
Possible	4	0	1	2	2	3	4
Occasional	5	0	1	2	3	4	4
Likely	6	0	1	2	3	4	4

A4.2 Table – Summary Consequence Definitions

Level	Ecological
Negligible	General - Insignificant impacts to habitat or populations, Unlikely to be measurable against background variability Target Stock/Non-retained: undetectable for this population By-product/Other Non-Retained: Area where fishing occurs is negligible compared to where the relevant stock of these species reside (< 1%) Protected Species: Relatively few are impacted. Ecosystem: Interactions may be occurring but it is unlikely that there would be any change outside of natural variation Habitat: Affecting < 1% of area of original habitat area <i>No Recovery Time Needed</i>
Minor	Target/Non-Retained: Possibly detectable but little impact on population size but none on their dynamics. By-product/Other non-retained: Take in this fishery is small (< 10% of total) compared to total take by all fisheries and these species are covered explicitly elsewhere. Take and area of capture by this fishery is small compared to known area of distribution (< 20%). Protected Species: Some are impacted but there is no impact on stock Ecosystem: Captured species do not play a keystone role – only minor changes in relative abundance of other constituents. Habitat: Possibly localised affects < 5% of total habitat area <i>Rapid recovery would occur if stopped - measured in days to months.</i>
Moderate	Target/Non Retained: Full exploitation rate where long term recruitment/dynamics not adversely impacted By-product: Relative area of, or susceptibility to capture is suspected to be less than 50% and species do not have vulnerable life history traits Protected Species: Levels of impact are at the maximum acceptable level Ecosystem: measurable changes to the ecosystem components without there being a major change in function. (no loss of components) Habitat: 5–30 % of habitat area is affected. :or, if occurring over wider area, level of impact to habitat not major <i>Recovery probably measured in months – years if activity stopped</i>

Level	Ecological
Severe	Target/Non Retained: Affecting recruitment levels of stocks/ or their capacity to increase By-product:Other Non-Retained: No information is available on the relative area or susceptibility to capture or on the vulnerability of life history traits of this type of species Relative levels of capture/susceptibility greater than 50% and species should be examined explicitly. Protected Species: Same as target species Ecosystem: Ecosystem function altered measurably and some function or components are missing/declining/increasing outside of historical range &/or allowed/facilitated new species to appear. Habitat: 30–60 % of habitat is affected/removed. <i>Recovery measured in years if stopped</i>
Major	Target/Non Retained: Likely to cause local extinctions By-product:Other non-retained:N/A Protected Species: same as target species Ecosystem: A major change to ecosystem structure and function (different dynamics now occur with different species/groups now the major targets of capture) Habitat: 60–90% affected <i>Recovery period measured in years to decades if stopped.</i>
Catastrophic	Target/NonRetained:Local extinctions are imminent/immediate By-product/Other Non-retained N/A Protected Species: same as target Ecosystem: Total collapse of ecosystem processes. Habitat: > 90% affected in a major way/removed <i>Long-term recovery period will be greater than decades or never, even if stopped</i>

A4.3 Table – Likelihood definitions

Level	Descriptor
Likely	It is expected to occur
Occasional	May occur
Possible	Some evidence to suggest this is possible here
Unlikely	Uncommon, but has been known to occur elsewhere
Rare	May occur in exceptional circumstances
Remote	Never heard of, but not impossible

APPENDIX 5. ACRONYMS

BRDs	Bycatch Reduction Devices
CAESS	Catch and Effort Statistics System
CPUE	Catch Per Unit Effort
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EA	Environment Australia
ED	Executive Director (of Department of Fisheries)
EGP	Exmouth Gulf Prawn Managed fishery
EGP Plan	Exmouth Gulf Prawn Management Plan 1989
EGPMAC	Exmouth Gulf Prawn Management Advisory Committee
EPBCA	Environment Protection and Biodiversity Conservation Act 1999
ESD	Ecologically Sustainable Development
FRDC	Fisheries Research and Development Corporation
FRMA	Fish Resources Management Act 1994
FRMR	Fish Resources Management Regulations 1995
GIS	Geographic Information System
MFLs	Managed Fishery Licenses
OAG	Office of the Auditor General
OCS	Offshore Constitutional Settlement
SA	South Australia
SCFA	Standing Committee for Fisheries and Agriculture
SRR	Stock-Recruitment Relationship
VMS	Vessel Monitoring System
WA	Western Australia
WAFIC	WA Fishing Industry Council

APPENDIX 6. RESEARCH

Project -Exmouth Gulf Prawns	Res.Group	Link	Gap	1970s	1980s	1990s	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04
TARGET STOCK MANAGEMENT													
1. Annual Stock Assessment													
Stock-recruit-enviro effects	FWA				✓	✓			x CR	x CR	x CR	x CR	x CR
Modelling (banana)	FWA						x CR		x CR	x CR	x CR	x CR	x CR
Yield/ recruit,\$/recruit	FWA												
Catch/ effort relationships (T and K)	FWA								✓		x CR	x CR	x CR
Economics/Stock enhancement	I/CSIRO/FWA								FRDC	FRDC			
Recruitment-catch relationship (T)	FWA								x CR	x CR	x CR	x CR	x CR
2. Fishery Databases													
Research log books	FWA			✓	✓	✓	✓	✓	✓	x CR	x CR	x CR	x CR
CAES returns/QAD	FWA			✓	✓	✓	✓	✓	✓	x CR	x CR	R	
Recruit, spawning stock indices	FWA					✓	✓	✓	✓	✓	x CR	x CR	x CR
Effort impact assessment (GIS)	FWA						✓	✓				x CR	x CR
Juvenile habitat monitoring	CSIRO/FWA								✓	FRDC	FRDC	(x) FRDC	(x) FRDC
Fishing power monitoring (quad)	FWA			✓	✓	✓	✓	✓	✓	R	x CR	x CR	x CR
Processors returns	I/FWA			✓	✓	✓	✓	✓	✓	x CR	x CR	x CR	x CR
Database maintenance	I/FWA								x CR	x CR	x CR	x CR	x CR
3. Biology													
Tigers													
Reproduction	FWA			✓	✓								
Growth	FWA		✓						✓		(x) CR	(x) CR	(x) CR
Habitat requirements	FWA/CSIRO							✓	FRDC	FRDC	(x) CR	(x) CR	(x) CR
Recruit distribution (temp. & spatial)	FWA				✓	✓							
Migration	FWA			✓									
Natural mortality	FWA		✓										
Catchability	FWA				✓				✓	✓	x CR		

Project -Exmouth Gulf Prawns	Res.Group	Link	Gap	1970s	1980s	1990s	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04
Kings													
Reproduction	FWA			✓									
Growth	FWA		✓								(x) CR	(x) CR	
Habitat requirements	FWA			✓									
Migration	FWA										(x) CR	(x) CR	
Natural mortality	FWA												
Catchability	FWA												
Endeavours													
Reproduction	FWA												
Growth	FWA		✓										
Habitat requirements	FWA		✓										
Migration	FWA		✓	✓									
Bananas													
Reproduction	FWA		✓										
Growth	FWA		✓										
Rainfall-recruitment-catch	FWA					✓							
ENVIRONMENTAL MANAGEMENT													
Bycatch monitoring	FWA							✓	✓	FRDC/CR	FRDC/CR	(x) FRDC	(x) FRDC
Biodiversity	FWA/Museum												
STOCK ENHANCEMENT/AQUACULTURE													
Modelling recruitment	CSIRO/FWA							✓					
Enhancement stock identity/ genetics	CSIRO								FRDC	x FRDC	x FRDC	(x) FRDC	(x) FRDC
Raceway culture	CSIRO								FRDC	x FRDC	x FRDC	(x) FRDC	(x) FRDC
Juvenile habitat survey(s)	CSIRO								FRDC	x FRDC			
SOCIOECONOMICS													
1. Resource allocation/native title													
Aquaculture						✓							
Native Title													

Project -Exmouth Gulf Prawns	Res.Group	Link	Gap	1970s	1980s	1990s	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04
2. Economics													
Average price data	I/FWA					✓							
Market research	I							✓	✓				
Fuel consumption/expenses	I									x CR	x CR	x CR	x CR
3. Gear, vessels and vessel design													
Gear development	I/FWA												
Bycatch reduction devices	I/FWA							✓	✓	FRDC/CR	FRDC/CR		
Net configurations - quad	I/FWA					✓	✓	✓	x				
Bison boards	FWA				✓								
Cod-end increases	FWA									x CR			
4. Public health/quality													
On board handling	I					✓							
Occ. Health and Safety	FWA/I												
Product quality certification	I												
FISHERY MANAGEMENT													
1. Fishing rules													
375 rule/umitisation	FWA				✓								
Compliance	FWA				✓						x FRDC	x FRDC	x FRDC
VMS	FWA												
Boundary (non trawl) "fixing"	FWA												

Research Group Key: FWA- Fisheries WA, **I** – Industry, **CSIRO WA**, **CSIRO QLD**

Project Status Key: - completed, **X** committed, **(X)** proposed but not approved/committed, **R** review

Funding Source: **CR-** cost recovery, **FRDC-** Fisheries Research and Development Corporation

APPENDIX 7. STOCK MONITORING SURVEYS IN EXMOUTH GULF

Objectives:

Obtain fishery independent information on the tiger prawn stocks:

- Level of recruitment to the fishery in March and April.
- Spawner biomass during August to September.
- Growth and movement patterns within surveyed areas.
- Delineate size distribution to enable closure lines to be set which optimise size of prawns caught.
- Obtain some understanding of the spatial and seasonal distribution patterns in conjunction with log book information.

Sampling techniques:

- Sampling is carried out using conventional fishing gear (quad gear) on commercial boats. The same two survey vessels are used.
- Trawl duration is 30 minutes to 2 hours and reflect real fishing times in this fishery.
- Systematic sampling in the same sites each survey period. These sites were determined using historical fishing patterns and the natural topography of the gulf.
- Recruitment surveys are carried out three times a year, early March, late March and early April. 13 sites are sampled over three nights during each period (Table 1, Figure 2).
- Spawning stock surveys are carried out three times, a month apart in August, September and October. 15 sites are sampled over five nights during each period (Table 1, Figure 1).
- Sampling is undertaken over the quarter moon phase for each survey.
- For each site, the start and end (and if turns are made) latitude and longitude are noted so that trawl distance can be calculated, the total catch (all prawn species) is recorded and a representative sample (~200 prawns) of tiger prawns is collected for each trawl. The sample is sexed and measured and occurrence of parasites noted. The reproductive stage of females (non-ripe (o), showing (I, II) and ripe (III, IV)) is also recorded.
- If sufficient numbers of king prawns are caught a representative sample is retained for measuring.
- The total catch (all species) is verified at unloading and all samples (males and females separated) are measured individually and added to the total.
- All data is entered into an ACCESS database for manipulation, analysis and report preparation. All spatial information is mapped with the GIS package ARCVIEW.

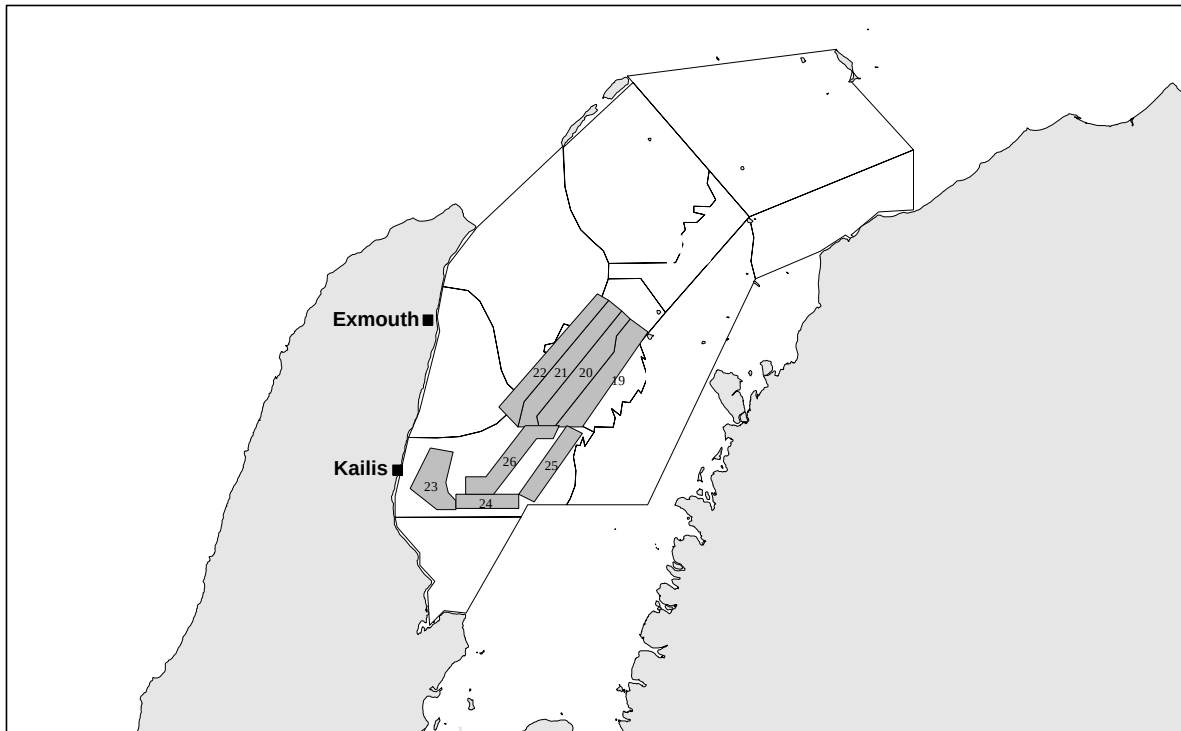


Figure 1. Spawning stock survey sites in Exmouth Gulf.

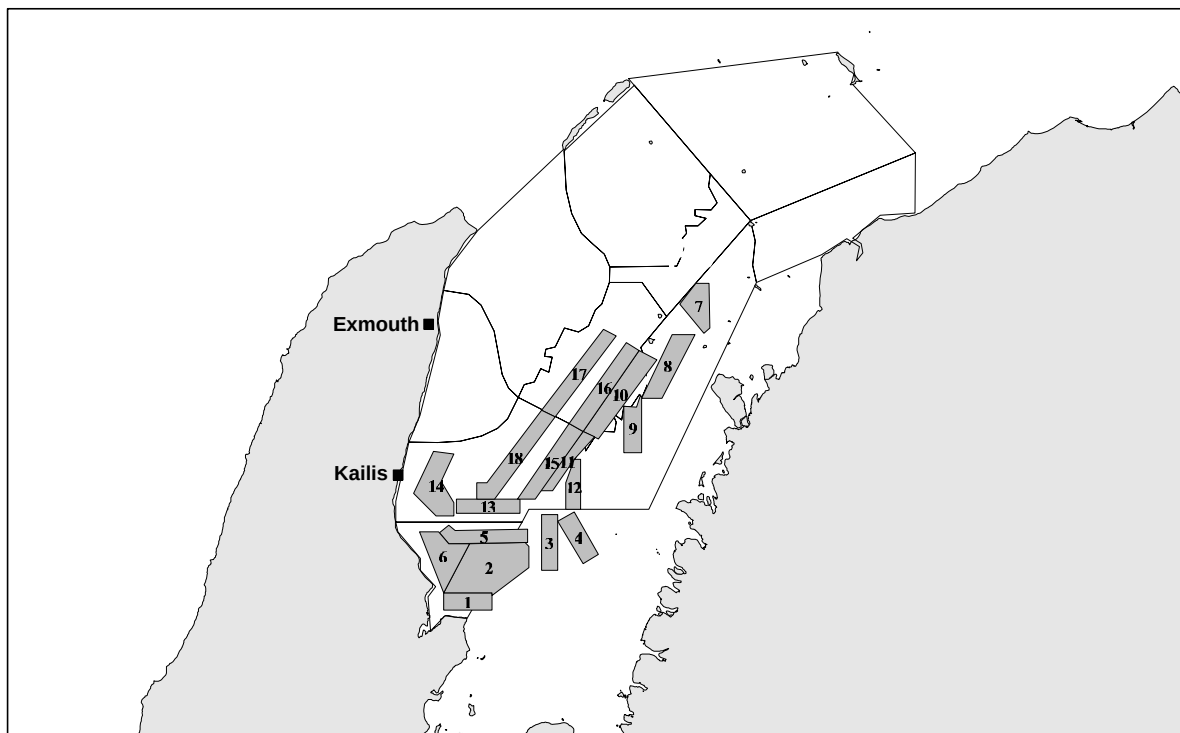


Figure 2. Recruitment survey sites in Exmouth Gulf.

Table 1. Site Location and sampling schedule for Exmouth Gulf fishery independent surveys.

The lat & longs represent the centroid for each survey site (replicate). These must be entered into the Prawn Log Book Dbase sys in place of the start lat & long on the nightly logsheet.

SITE NO.	SURVEY	AREA	LOCATION	SHOT (mins)	LAT	LONG	COMMENTS
1	Recruit.	Q3 (Lower Gulf)	Bay of Rest	120	22° 16.9'	114° 10.8'	
2	Recruit.		Schofield	120	22° 14.2'	114° 14.4'	Enter as 114° 13.0'
3	Recruit.		Snapper	60	22° 12.5'	114° 17.2'	PNA
4	Recruit.		Whalebone	30	22° 12.2'	114° 19.5'	PNA
5	Recruit.		6 Fathom bank	120	22° 12.0'	114° 12.2'	
6	Recruit.		Wapet	120	22° 13.5'	114° 8.7'	
7	Recruit.	P2 (East Gulf)	Somerville	90	21° 54.7'	114° 29.0'	
8	Recruit.		S E Y Island	90	21° 59.2'	114° 26.6'	
9	Recruit.		Hayward	60	22° 3.7'	114° 23.6'	
10	Recruit.		West 6 Fthm Bank Q1	60	22° 1.6'	114° 22.9'	
11	Recruit.		West 6 Fthm Bank Q2	60	22° 7.2'	114° 18.1'	
12	Recruit.		Larkin	60	22° 8.2'	114° 19.2'	
13	Recruit.		E-W 22° 10'	120	22° 9.5'	114° 12.8'	
14	Recruit.	Q1/Q2 (Mid Gulf)	Stewart Shoal	120	22° 8.4'	114° 7.8'	
15	Recruit.		B/C line Q2 (South)	120	22° 7.0'	114° 17.1'	
16	Recruit.		B/C Line Q1 (North)	120	22° 0.8'	114° 21.6'	
17	Recruit.		Heron Line Q1 (North)	120	21° 59.7'	114° 19.4'	
18	Recruit.		Heron Line Q2 (South)	120	22° 6.3'	114° 14.3'	
19	Spawning	Q1	Shot 1 East	150	22° 0.8'	114° 22.6'	
20	Spawning		Shot 2	150	22° 0.1'	114° 20.1'	
21	Spawning		Shot 3	150	21° 59.4'	114° 18.7'	
22	Spawning		Shot 4 West	150	21° 58.9'	114° 17.5'	
23	Spawning	Q2	Shot 1 (Stewart)	150	22° 8.4'	114° 7.8'	
24	Spawning		Shot 2 (22° 10')	150	22° 9.9'	114° 12.4'	
25	Spawning		Shot 3 (B/C line)	150	22° 6.9'	114° 17.4'	
26	Spawning		Shot 4 (Middles)	150	22° 6.8'	114° 14.0'	

Early March
Late March
April

August
September
October

Implementation of Bycatch Reduction Devices into Western Australian Trawl Fisheries – observer program

1. Introduction

An observer program commenced in 2000 as part of this program of implementation of bycatch reduction devices into the major trawl fisheries in Western Australia (FRDC 2000/189). Up until December 2001, 118 observer nights (1,018 trawls, 1,068 hours of trawling) have been spent on commercial vessels in Shark Bay and 40 observer nights (216 trawls, 530 hours) have been spent in Exmouth Gulf during 2000 and 2001. Some additional observer and skipper log book information was collected in 1998 and 1999 for the Shark Bay prawn fishery. In addition to observers collecting data on commercial vessels during normal fishing operations, experimental trials have also been conducted on various grid types for the Shark Bay prawn, scallop and Exmouth Gulf prawn fisheries during 2000. These will be reported in the final report.

2. Methods

On vessels with departmental observers, commercial catch and bycatch is recorded for most trawl shots conducted. A shot is defined as a trawl of two nets (or four in Exmouth Gulf), one port side of the boat and the other starboard, for an unfixed duration of time. Each boat generally towed two types of nets: a control or standard net (one that fishers typically used prior to the trialing of grids) and one fitted with some type of bycatch reduction device (BRD).

The categories recorded for each side (port and starboard side (side with BRD noted)) were; total bycatch weight or volume (small fish, crustaceans, echinoderms and molluscs), target species catch (king, tiger, endeavour, coral prawns and scallops) and numbers of sharks, rays, sea snakes, sponges and turtles. In Shark Bay, the number of pink snapper (*Pagrus auratus*) were also noted and their size composition recorded for some trawls.

The quantity of various types of catch taken by the control net, to that taken by the net fitted with a BRD are compared. Catch types considered, include:

- Large animal numbers were recorded separately and included;
 - Sharks;
 - Rays;
 - Turtles;
 - Seasnakes; and
 - Sponges.
- Total catch (kg) for each species of prawn; king (*Penaeus latisulcatus*), tiger (*Penaeus esculentus*), endeavour (*Metapenaeus endeavouri*) and coral (mixture of small species but mainly *Metapenaeopsis crassissima*) prawns. This did not include broken or soft prawns;
- Quantity (kg) of soft and broken (kg) prawns;
- Scallops (baskets)
- By-catch volume (baskets). By-catch volume was recorded for all other small finfish and invertebrate species retained by the trawl excluding large animals.
- Pink snapper in Shark Bay (numbers and some length frequency information)
- Weed (baskets)

APPENDIX 8. MATERIALS SUPPLIED TO ENVIRONMENT AUSTRALIA AGAINST THEIR SPECIFIC GUIDELINES

4. ASSESSMENT OF THE EGP MANAGEMENT REGIME AGAINST THE COMMONWEALTH (EA) GUIDELINES FOR ASSESSING THE ECOLOGICALLY SUSTAINABLE MANAGEMENT OF FISHERIES

GENERAL REQUIREMENTS OF THE EA GUIDELINES

The management arrangements must be:

Documented, publicly available and transparent

As per the FRMA (1994) “the Executive Director is to cause a copy of every order, regulation and management plan in force under this Act –

- *To be kept at the head office of the Department; and*
- *To be available for inspection free of charge by members of the public at that office during normal office hours.”*

In addition to these legislative requirements, the current management regime, as documented in the formal set of management regulations, can be purchased by interested parties from the State Law Publisher.

Of more relevance, is that any discussion papers and proposals for modifications to these management arrangements are distributed widely to stakeholder groups automatically and other interested individuals by request in hard copy format. Where appropriate, they are now also available from the Departmental web site www.fish.wa.gov.au.

Finally, once completed, the full ESD Report on the EGP fishery will be made publicly available via publication and electronically from the Departmental website. This will provide increased transparency through explicitly stating objectives, indicators, performance measures, management arrangements for each issue and how the fishery is currently performing against these criteria.

Developed through a consultative process providing opportunity to all interested and affected parties, including the general public

S64 and S65 of the FRMA (1994) define the requirement for procedures that must be undertaken before determining or amending all management plans. More specifically, the management arrangements for the EGP fishery have been developed through formal consultation with industry and the general public, which includes the EGPMAC, and also from requested submissions from industry groups (e.g. WA Fishing Industry Council - WAFIC), other stakeholder groups (e.g. Recfishwest, Conservation Council of WA) and the general public.

The ESD Report for the EGP fishery was developed through a consultative process that included a wide variety of stakeholders including members of the Exmouth Gulf prawn trawl industry, government (Departments of Fisheries, Conservation and Environment), recreational groups (Recfishwest), non-government environmental groups (Conservation Council of WA), Environment Australia and invited specialists (WA Museum, University of WA). Details of the methodology used to generate this

report including how the issues were identified, how these identified issues were subjected to a risk assessment, and how the objectives etc. were developed are described in Section 3.5. Attendees at each of the workshops are listed in Appendix 3.

Ensure that a range of expertise and community interests are involved in individual fishery management committees and during the stock assessment process.

The range of expertise and community interests that have been involved in the process of determining management and reviewing stock assessments is extensive. The groups that have been involved in the generation and review of the information contained in this report include:

- Department of Fisheries, WA;
- Department of Environment, WA;
- Department of Conservation and Land Management (CALM), WA;
- The trawling industry;
- Western Australian Fishing Industry Council (WAFIC);
- Recfishwest;
- Conservation Council of WA;
- Museum of WA; and
- The University of WA.

The general consultation methods used for this fishery are summarised in the Governance Section 5.4.3.1. The attendee lists for the 2 meetings are listed in Appendix 3.

Be strategic, containing objectives and performance criteria by which the effectiveness of the management arrangements is measured.

The ESD Component Reports (see Section 5) contain the objectives, indicators and performance measures for measuring the effectiveness of the management arrangements for the EGP fishery. For some components, the objectives, indicators and performance measures are well established and the data are available to demonstrate levels of performance over time. For other components, the objectives, indicators and performance measures have only just been developed and/or the necessary data collection is only just being initiated. The status of this information is documented within each of the individual component reports within the ESD Reports in Section 5.

Be capable of controlling the level of harvest in the fishery using input and/or output controls.

The FRMA (1994), and specifically the management plan for the EGP fishery provides the legislative ability to control the level of harvest within this fishery. This is achieved through the use of a sophisticated and effective combination of input control measures based upon limiting the number of vessels allowed to operate in the fishery, the amount (and type) of gear each of these boats may use, along with a comprehensive set of seasonal and spatial closures.

These arrangements have been varied during the past 40 years to ensure that management remains appropriate to achieve the sustainability objectives for the fishery. Thus there have been both permanent and temporary reductions in the numbers of vessels allowed to operate; changes to compliance policing (e.g.VMS will be fitted to vessels); changes to gear requirements (e.g.BRDs will be introduced); and changes to permanent and temporary closures.

Contain the means of enforcing critical aspects of the management arrangements.

The Department employs a large number of operational staff to ensure compliance with the critical

aspects of the management arrangements for the EGP fishery. This includes at sea patrols to ensure the closed seasons and closed areas, which will be assisted by the imminent introduction of VMS. Various on-shore inspections are used to check that restrictions on gear and other operational rules are being adhered to.

Given the value of the licences, fishers themselves are also a source of information on illegal activities. A full summary of these compliance activities and their effectiveness is provided in Section 5.4.1.3.

Provide for the periodic review of the performance of the fishery management arrangements and the management strategies, objectives and criteria.

There is an annual review of the performance of the major aspects of the EGP fishery through the completion of the “State of the Fisheries” report. This is updated and published each year following review by the Office of the Auditor General (OAG). It forms an essential supplement to the Department’s Annual Report to the WA Parliament with the latest version located on the Departmental website www.fish.wa.gov.au.

The ESD Component Reports contain comprehensive performance evaluations of the EGP fishery based upon the framework described in the Fisheries ESD policy (Fletcher, 2001). This includes the development of objectives, indicators and performance measures for most aspects of this fishery and includes status reports for those components that are not subject to annual assessment. This full assessment, including an examination of the validity of the objectives and performance measures, will be completed and reviewed externally every five years.

Be capable of assessing, monitoring and avoiding, remedying or mitigating any adverse impacts on the wider marine ecosystem in which the target species lives and the fishery operates.

Capabilities for the assessment, monitoring and avoidance, remedying or mitigating any adverse impacts on the wider marine ecosystem are documented in “General Ecosystem” Section 5.3. This has been completed through a formal risk assessment analysis of the issues and, where necessary, the development of suitable monitoring programs.

Require compliance with relevant threat abatement plans, recovery plans, the National Policy on Fisheries Bycatch, and bycatch action strategies developed under that policy.

The management regime complies with all the relevant threat abatement plans for species where there are significant interactions. Details are provided in the ‘non-retained species’ Section of the ESD Report includes the strategies that will be released in the Bycatch Action Plan for this fishery (Section 5.2.).

PRINCIPLE 1 OF THE COMMONWEALTH GUIDELINES

OBJECTIVE 1 MAINTAIN VIABLE STOCK LEVELS OF TARGET SPECIES

A fishery shall be conducted at catch levels that maintain ecologically viable stock levels at an agreed point or range, with acceptable levels of probability.

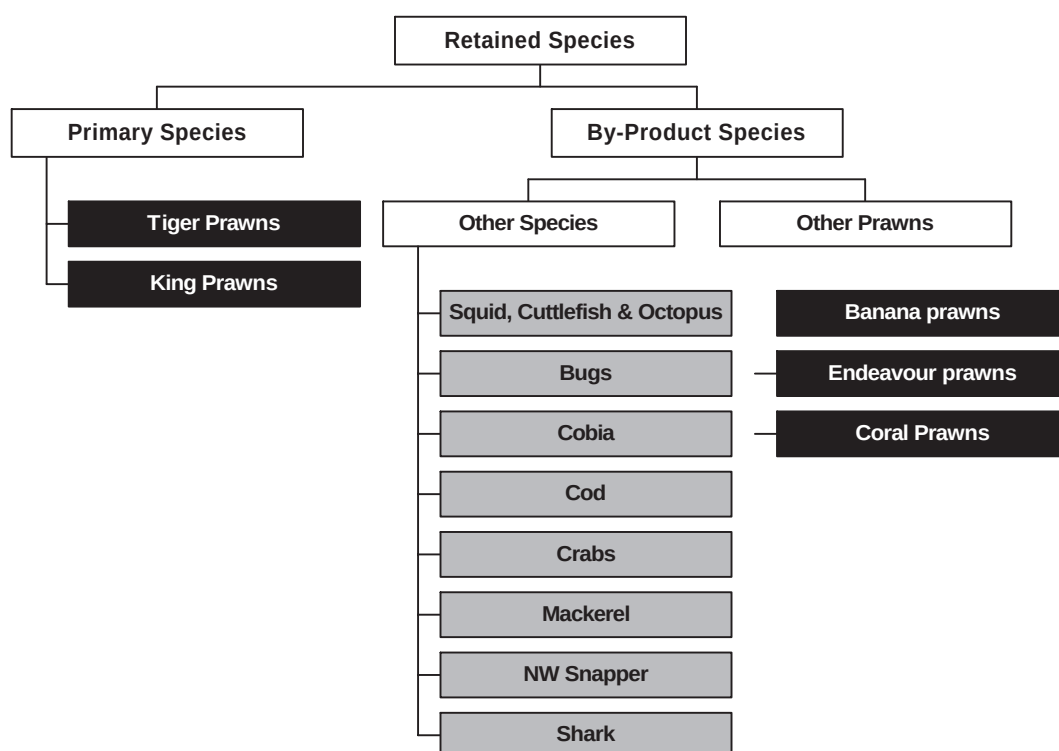
The component tree detailing the retained species within the EGP fishery is shown below. Each of the target species/groups retained by this fishery has been assessed with the appropriately detailed reports having been compiled (see Section 5.1). Only the tiger prawn (*Penaeus esculentus*) was ranked as a high enough risk rating (**MODERATE Risk**) to warrant detailed attention (Section 5.1.1.1). Although, king prawns (*Penaeus latisulcatus*), endeavour prawns (*Metapenaeus endeavouri*), banana prawns (*Penaeus merguensis*), and coral prawns (*Metapenaeopsis crassissima*) were all given a **LOW Risk** rating, full reports were prepared for each due to the importance of these species to the fishery (Section 5.1.1.1, 5.1.1.2 and 5.1.1.3, 5.1.1.4 and 5.1.2.1).

Full justifications for not completing on-going annual assessments for the other nine components (which are all by-product species) are located in Section 5.1.2. This decision was largely related to the relatively small quantities of these by-product species taken by the EGP fishery.

Assessments of current performance demonstrate that all of the prawn species are being maintained above levels necessary to maintain ecologically viable stock levels. Thus, in summary:

- The breeding stock level for the tiger prawn stock in Exmouth Gulf is currently above the agreed reference point.
- The historical catch and effort trends over the past 40 years indicate that there has been no decline in the production levels for king prawn in Exmouth Gulf, which is consistent with there being sufficient on-going levels of spawning biomass for this species.
- Historical catch trends indicate that the production levels for endeavour and banana prawns remain within natural environmental levels, which is consistent with the recruitment potential of these species having not been affected by the fishery.
- The level of capture of other by-product species by this fishery is too small to have a significant impact on their dynamics.

Consequently, this fishery is meeting the requirements of Principle 1 of the Commonwealth Guidelines.



Information requirements

1.1.1 There is a reliable data collection system in place appropriate to the scale of the fishery. The level of data collection should be based upon an appropriate degree of fishery independent as well as fishery dependent research and monitoring.

A substantial level of information is collected on the EGP fishery. Data are collected through a combination of fishery dependent and fishery independent systems, many of which have been in place

for decades. These ongoing monitoring programs are supported by a long history of research programs on the biology and ecology of prawns along the west coast of WA.

The specific data requirements needed to assess performance for each of the relevant objectives are detailed in the relevant sections of the ESD reports in Section 5.1 Retained Species. The requirements are summarised as follows:

Monitoring Program Information Collected Robustness² Fishery independent spawning surveys Annual biological survey that measures the catch rates in different areas of Exmouth Gulf and used to determine the spawning stock abundance of tiger prawns Medium/High Voluntary daily log books Hours fished, areas of operation, and estimated catch per trawl High Fishery independent recruitment surveys Provides an index of annual recruitment High Vessel monitoring system (VMS) Location and speed of vessels will be implemented by the Dept of Fisheries for managing compliance of closures in 2002/03 High Catch and Effort Statistics System (CAESS) Monthly catch and days fished Medium Climatic data Monthly Fremantle Sea Level data- used to estimate strength of Leeuwin Current; Rainfall data; Wind data and Swell Height Conditions High

Assessments

1.1.2 There is a robust assessment of the dynamics and status of the stock dynamics and status for the target species. Review should ideally take place every year, and no greater than three years should elapse between reviews.

The two main target species for the EGP fishery, the tiger and king prawns are both classified as fully exploited.

King Prawns

The catches of king prawns are monitored every year through fishery dependent surveys (voluntary log books information or catch and effort) and assessed against the acceptable range of catches.

There is a long time series of catch and effort information for this fishery (Figure 10). Production levels from the 1970s to the 1990s provide no evidence of a stock-recruitment relationship (SRR) for king prawns. The catches of king prawns are related to the level of effort and have been within the acceptable range for this fishery for the last ten years. The slightly lower catch in 2000 resulted from the dispersion of stock away from traditional fishing grounds, due to impacts from cyclonic activity, which made them less available to the fleet.

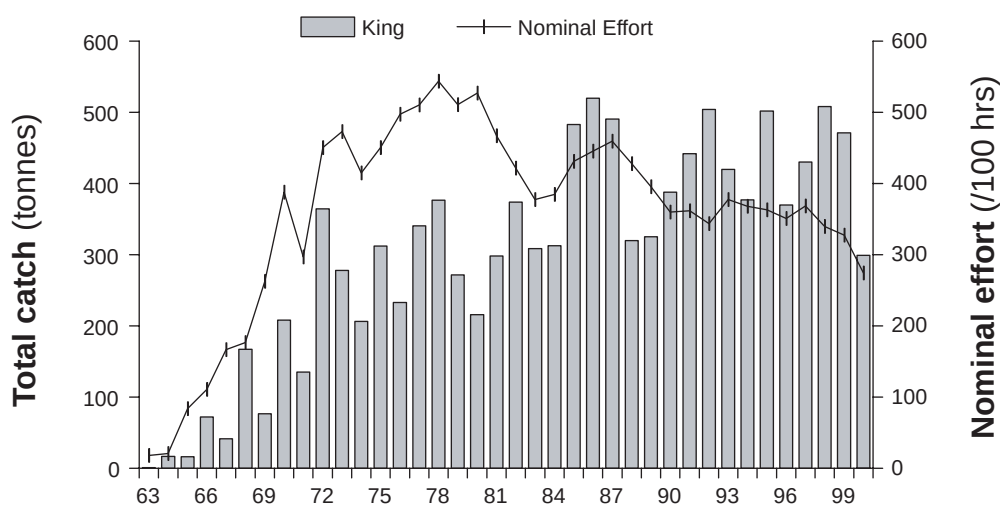


Figure 10. Catch of king prawns by the EGP fishery.

² The level of robustness of these measures is discussed in full within each of the relevant component reports in Section 5.

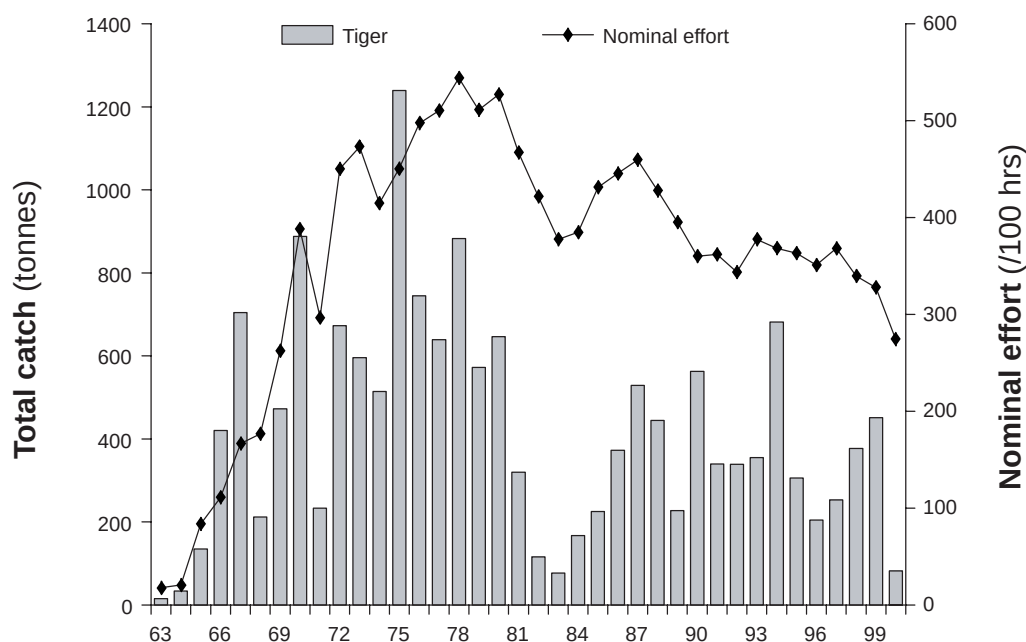


Figure 11. Historical catch and nominal effort for tiger prawns in EGP fishery.

Tiger Prawns

For tiger prawns, the assessment of spawning biomass is supported by the recent indices of recruitment and spawning stock with respect to the accepted SRR. A decline and subsequent recovery of the stock occurred previously during the history of this fishery (Figure 11) and the cause was identified as overfishing during the early 1980s. The current status of the spawning stock for the tiger prawn is assessed every year using a synthesis of information obtained from both fishery independent and dependent surveys.

The spawning index (catch rate, kg/hr) observed in tiger prawn spawning areas (Q1 and Q2) have varied between 8 and 25 kg/hr over the last five years and are therefore considered adequate under normal environmental conditions (Table 4). The high spawning stock levels in 1999 (25 kg/hr), however, produced very low recruitment in 2000 as a result of adverse environmental conditions due to cyclonic events. This caused a reduction in the fishing season and catch as well as lower than optimal levels of spawning stock from August to October 2000 despite minimal fishing on recruits. Normal environmental conditions have been experienced during 2000/01 and recruitment levels and overall stock abundance have increased in 2001.

Table 4. Exmouth gulf tiger prawn spawning stock indices survey results for last 6 years.

Year	Total Landings	Spawning Q1	Index Q2
1996	205	8.0	14.7
1997	253	8.6	16.4
1998	377	10.4	17.4
1999	451	25.1	25.7
2000	82	10.3	7.4
2001	208	16.2	18.9

Full details of the current evaluation and a discussion of the robustness of the analyses used are located in 5.1.1.1 and 5.1.1.2. These assessments are reported annually within the State of the Fisheries Report.

1.1.3 The distribution and spatial structure of the stock(s) has been established.

The distribution of both the tiger and king prawn has been well documented. The tiger prawn is generally regarded as an endemic Australian species and it occurs in Western Australia, Northern Territory and Queensland. The king prawn has been reported in a variety of regions worldwide and in Australia occurs from South Australia, Western Australia, Northern Territory, Queensland and down the east coast to northern New South Wales.

Whilst both species have a broad overall distribution across at least the northern half of Australia, due largely to the habitat requirements of their juveniles, they each have a number of separated locations where their abundance is sufficient enough to allow commercial fishing to occur. Thus, the prawns caught by the EGP fishery can be considered to have come from functionally separate stocks than other regions where fishing for these species occurs. More information on the distribution for both species and for coral and endeavour prawns is contained within Section 2, Background Information.

1.1.4 There are reliable estimates of all removals, including commercial (including discards), recreational and indigenous, from the fished stock. These estimates have been factored into stock assessments and target species catch levels.

Within the list of monitoring programs outlined above for the EGP fishery, data covering each of these sources of removal are outlined. In most cases, these data are collected annually or at least on a sufficiently frequent basis to ensure robust estimates are available. Given the nature of this fishery, only the estimates of removals by the commercial sector are required and these are collected on a daily to monthly basis during the fishing season. There are no significant recreational or indigenous fisheries for prawns in Exmouth Gulf. Furthermore, there is a minimal likelihood of a significant level of illegal capture of prawns by the commercial fleet.

Sector	Catch Data Collected	Frequency
Commercial	Fishers monthly returns, Processor unload records, Voluntary daily log books, On-board observer data	Daily or monthly during the season
Recreational	N/A – there is no recreational aspect to this fishery	N/A
Indigenous	N/A – no known fisheries;	N/A
Illegal	N/A	N/A

1.1.5 There is a sound estimate of the potential productivity (maximum safe long term yield) of the fished stock/s.

The long history of this fishery (nearly 40 years) combined with the significant level of monitoring and research that has been done on the dynamics of this stock has enabled a very reliable estimate of sustainable yield to be calculated for the EGP fishery. Thus, the stock recruitment relationship and associated management arrangements and trigger points developed for tiger prawns in Exmouth Gulf are often used as case studies for prawn fisheries around the world.

Tiger Prawns

The use of a constant escapement policy for the management of tiger prawn stocks ensures the spawning biomass does not fall below the minimum level. Consequently, this provides a very robust way of determining annual yield. Such a flexible method for determining what yield can be taken each year is vital in fisheries capturing species that naturally have large variations in recruitment strength. Thus, in years where recruitment is relatively good, a relatively large yield can be taken, but in years where the recruitment levels are relatively low, less can be taken before the threshold catch rate is reached. With this type of management it is possible that there could be almost no fishing in seasons where recruitment levels are particularly poor.

Given the history of this fishery and normal environmental fluctuations, the catch of tiger prawns by the EGP fishery should be within the range of 205-682 tonnes. This is described as the acceptable catch range and is assessed annually. Any deviation outside of this range must now trigger a review of the situation.

King Prawns

Because the major constraints on the fishery are designed to protect the tiger prawn stocks, and the king prawns are a more robust species in this environment, no definitive relationship for stock and recruitment has been identified for king prawn stocks (i.e. the stock has never been reduced to levels where this has been an issue). Thus, while there is no limit reference point for this species, an acceptable catch range was generated from catches spanning approximately 10 years, which covers most environmental variations.

The acceptable catch range for king prawns is 350–500 tonnes.

Management Responses

1.1.6 There is a limit reference point, which is the biological and/or effort bottomline beyond, which the stock should not be taken.

Tiger Prawns

Estimates of the level of spawning stock and the associated level of egg production have been obtained from two programs conducted by the Department of Fisheries. Historically (prior to 1982), the fishery-dependent CPUE (catch per unit effort) for the fishery in the main spawning areas was used. Due to the new trawl closures for the spawning areas introduced in recent years, the commercial fishers are not collecting the information needed to estimate the spawning stock abundance. As a result of the lack of information available through the voluntary log books, fishery-independent data are now required. Since 1982, the fishery independent systematic surveys of the breeding grounds have been conducted to determine catch rates for specific areas and are used as an index of spawning stock abundance.

The catch rate of the research survey of tiger prawn spawning stock index should be above 8-10 kg/standardised hr (see Table 4 above for survey values for the last 5 years). This equates to a catch rate by the fishery of 16kg/hr for twin gear and 19kg/hr for quad gear. This catch rate threshold operates on a constant escapement policy. Therefore, once the threshold catch rate is reached tiger prawn spawning areas are closed to ensure protection of adequate remaining stock. The full justification for selecting this reference point and current performance against this measure is described in Section 5.1.1.1.

King Prawns

The limit reference point for king prawns is that the catch should not be more than 500 tonnes. The total catch of king prawns should be within the acceptable catch range of 350-500 tonnes for this species. If the fishery exceeds this range (either above or below), this would trigger a review of the fishery.

The full justification for selecting this reference point and current performance against this measure is described in Section 5.1.1.2.

1.1.7 There are management strategies in place capable of controlling the level of take.

A full description of the management arrangements for the commercial fishery is located in the attached management plan. A full discussion of the main regulations and their justifications are located in Section 2.1. In summary, these arrangements include:

- Small numbers of vessels and a limited entry fishery
- Fixed seasonal closures (November – April)
- Real time monitoring of fleet dynamics and operations by departmental staff
- Variable spawning/size season closures (areas closed or opened depending upon catch rates and sizes of prawns)
- Area closures to preserve sensitive habitats that are essential nursery areas for prawns and other species
- Time closures- this now includes full moon closures
- Input controls on gear and vessel equipment

Significant effort is put into ensuring adequate compliance with these regulations. This includes at sea and aerial patrols to ensure closed seasons and closed areas, and operational rules are being adhered to. The use of VMS in 2002/03 on the vessels will help the Department of Fisheries monitor vessel location and speed, thus increasing compliance with closures while decreasing the need for untargeted patrol activities.

1.1.8 Fishing is conducted in a manner that does not threaten stocks of by-product species.

Full descriptions of the information available and the levels of risk of an impact on these by-product species by the EGP fishery are located in Section 5.1.2. Whilst none of the by-product species rated as having sufficient risk to require specific ongoing monitoring the three by-product prawn species are assessed annually as part of the ongoing management of the fishery. The EGP fishery catches only minor amounts of other ‘non-prawn’ by-product species and their management will be covered within other fisheries environmental assessments.

A number of the monitoring programs that are currently in place for the EGP fishery also provide relevant information on the by-product species. Even though this fishery does not target endeavour prawns, banana prawns, and coral prawns, a reasonable amount of each are caught every year. As a result, an assessment of each species is completed annually using an analysis of catch rates calculated from data collected by the voluntary daily log books. Total catch is used to assess the level of exploitation for all three of the by-product prawn species. The acceptable catch range of 120–300 tonnes for endeavour prawns and 20–100 tonnes for coral prawns was generated from a ten-year range of catch for each of these species. Since catches for banana prawns are highly variable and related to the amount of rainfall recorded in a region, the acceptable catch range for this species reflects its natural variability. Therefore, in years where significant rainfall is recorded the acceptable catch range is 10–60 tonnes and in years of low rainfall the catch range is 0-2 tonnes. Full justifications for this approach are located in Sections 5.1.1.3, 5.1.1.4 and 5.1.2.1.

1.1.9 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

Management actions taken over the past 20 years have been extremely effective and there is, therefore, a very high probability that they will continue to achieve the main objective of maintaining the spawning stock/biomass for all the prawn species retained in the EGP fishery. The management responses that are currently in place for the EGP fishery are very detailed, both for current actions, future actions and if the performance limits are reached/approached (see Sections 5.1.1.1 and 5.1.1.2). This fishery is managed on a real time basis, including the use of average sizes and daily catch rates of the fleet determining how and where the fishery can operate.

Furthermore, the additional use of catch based performance measures (acceptable ranges) for both tiger and king prawns, enables the Department of Fisheries to respond when changes outside the normal variations occur to ensure the maintenance of the spawning stock for both species. If the probability of these performance limits being reached increased, management arrangements could be implemented. This minimises the chances that factors such as significant effective effort creep can occur undetected.

Strategies available to offer further protection to the spawning stock for both tiger and king prawns, if required, include:

Tiger prawns

- Within the season- if catch rate falls below an average of 19 kg/hr (quad gear equivalent) in key tiger prawn trawl grounds, the area is closed to fishing for the remainder of the season.
- End of the season- if spawning stock survey is below an average of 19 kg/hr then the catch rate that closes the fishery may be increased in the following season.

King Prawns

- Further reductions in the total effort expended in the fishery.
- A reduction in the length of the fishing season or within season closures.
- Area closures.
- Extension of moon closures.

OBJECTIVE 2. RECOVERY OF STOCKS

Where the fished stocks are below a defined reference point, the fishery will be managed to promote recovery to ecologically viable stock levels within nominated timeframes.

There are no stocks within the EGP fishery that are currently below defined reference points/limits.

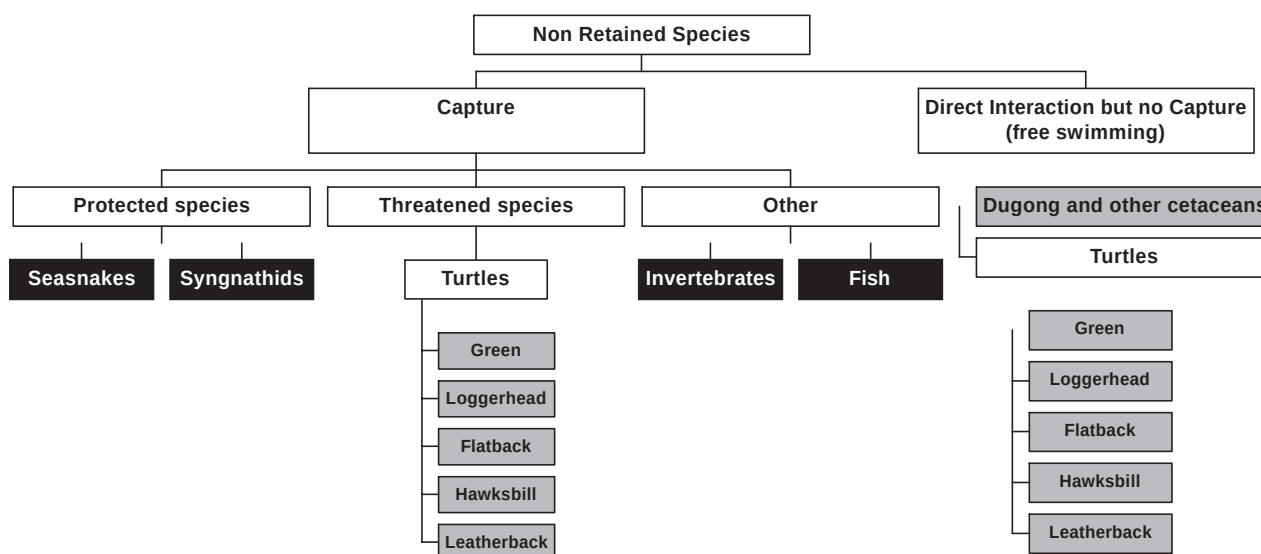
PRINCIPLE 2 OF THE COMMONWEALTH GUIDELINES

OBJECTIVE 1. BYCATCH

The fishery is conducted in a manner that does not threaten bycatch species.

Although fifteen non-retained species were identified in this fishery, all of them were ranked as either NEGLIGIBLE or LOW risks (see component tree below). Furthermore, six of the fifteen issues relate to species not actually being captured in the net, but only affected by general fishing operations. The threatened and protected species (e.g. turtles, syngnathids, seasnakes) are covered in objective 2.2, the remaining non-retained (bycatch) species are covered under objective 2.1.

Comprehensive reports on each of these bycatch (non-retained) species are presented in Section 5.2 NON-RETAINED SPECIES. These assessments indicate that the performance of the EGP fishery is currently adequate in not threatening any of the bycatch (non-retained) species, including the threatened and protected species, and is therefore meeting objectives 1 and 2 of Principle 2.



Information Requirements

2.1.1 Reliable information, appropriate to the scale of the fishery, is collected on the composition and abundance of bycatch.

Currently, there is limited existing information on the level and nature of bycatch in the fishery and about the bycatch at the commencement and other stages over the history of the fishery. The extent of information thus far is contained in the CAESS Data Information on declared non-target catch in the fishery (monthly returns) and limited field observations. A current FRDC funded program on the implementation of bycatch reduction devices will collect additional information on bycatch and by-product species. This program commenced in 2000 and is due to be completed by 2002. Another project funded by FRDC is looking at the inshore fish assemblages of the Pilbara and Kimberley coasts and quantifying inshore and trawl caught fish species in Exmouth Gulf. Through these new programs, information on bycatch is greatly improving for this fishery and will continue to improve with the addition of future research.

Assessments

2.1.2 There is a risk analysis of the bycatch with respect to its vulnerability to fishing.

A formal risk assessment for each of the identified non-retained/bycatch species (including those with direct interaction but no capture) was completed (see Section 3.4 for details). As previously mentioned, none of the non-retained species were given beyond a LOW risk rating.

Discarded Fish – Summary

ERA Risk Rating (C1 L4 NEGLIGIBLE)

Since trawling is a non-selective form of fishing, other species, which include adult small species and juveniles of other larger fish, are caught. Since these fish are generally not of commercial value, they

are discarded. A relatively low amount of discards is generated from this fishery, probably because of the bottom type over which it operates. The relatively small area of fishing compared to the overall area where these species probably occur, should result in their level of mortality being sustainable. Furthermore, with the introduction of secondary Bycatch Reduction Devices in the nets from 2002/03, the overall amount of small fish caught will further be reduced. For full details see 5.2.1.8.

Invertebrates – Summary

ERA Risk Rating (C0 L5 NEGLIGIBLE)

Although the trawl gear interacts with the sea bottom where many of these species reside, the configuration of the trawl gear precludes the capture of invertebrate species that live on top of or within the substrate. In addition, anecdotal evidence suggests that the trawl areas of Exmouth Gulf are typically sandy or mud bottoms and contain few large invertebrates. For full details see 5.2.1.9.

Management Responses

2.1.3 Measures are in place to avoid capture and mortality of bycatch species unless it is determined that the level of catch is sustainable (except in relation to endangered, threatened or protected species). Steps must be taken to develop suitable technology if none is available.

The fishery only operates in a very small proportion of the Exmouth Gulf region and the fishing season only lasts for 6 months of the year. This greatly reduces the impacts on any of these affected species.

In 2003, 100% BRDs in the form of large grids and secondary devices (such as square mesh panels) were made mandatory throughout the fleet. As previously mentioned, the Department of Fisheries will be undertaking a survey of bycatch species throughout Exmouth Gulf in order to ensure that bycatch species are adequately represented outside the trawl grounds to ensure sufficient refuge for these species.

2.1.4 An indicator group of bycatch species is monitored.

Due to the minimal risks associated with this group of non-retained species, it is not necessary to monitor any of these species in the longer term. This may be confirmed once the monitoring data from the FRDC study is completed.

2.1.5 There are decision rules that trigger additional management measures when there is significant perturbation in the indicator species numbers.

The risks associated with this group of species will be reassessed at the next major review of this fishery. This will occur within five years, as a requirement of the WA ESD policy.

2.1.6 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

Given the relatively low levels of interactions of the EGP fishery with non-retained species and the introduction of BRDs within the next two seasons, it is unlikely there will be an increase in the level of impact on these species by the EGP fishery. Nonetheless, as monitoring data become more available, the suitability of the current performance limits may need to be reviewed. If they are inappropriate and/or the level of interactions increases, appropriate alterations to practices will be taken.

A draft bycatch action plan that incorporates and deals with the issues identified in this report will

be released for comment in 2002. This plan will outline the proposals to deal with these issues as summarised in this report.

OBJECTIVE 2.

The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species and avoids or minimises impacts on threatened ecological communities.

Information Requirements

2.2.1 Reliable information is collected on the interaction with endangered, threatened or protected species and threatened ecological communities.

The extent of information on these issues comes from the CAESS data (commonly known as Monthly Returns) on declared non-target catch in the fishery and extensive fishery-independent field observations during research surveys carried out since 1983. The voluntary daily log books also contain the ability to record interactions with each of these species.

Research is now progressing within the fishery to collect reliable information on the interaction between the fishing fleet and bycatch species. A current FRDC funded program on the implementation of bycatch reduction devices will collect additional information on bycatch and by-product species. This program commenced in 2000 and is due to be completed by 2002 and will greatly improve the information levels for this fishery. The knowledge and understanding will continue to improve with the addition of future research.

Previously the only specific information available on turtles was from the sparse data collected by the Department of Conservation and Land Management, which has the legislative responsibility for these species within WA waters.

Assessments

2.2.2 There is an assessment of the impact of the fishery on endangered, threatened or protected species.

A formal risk assessment for each of the identified non-retained/bycatch species/groups (including those with direct interaction but no capture) was completed (see Section 3.4 for details). In the capture category for non-retained species, the assessment concluded that the EGP fishery was a negligible risk to seasnakes, syngnathids, green turtles, flatback turtles, loggerhead turtles, hawksbill turtles and leatherback turtles. For the direct interaction but no capture category for non-retained species, this assessment concluded that the fishery was of negligible risk to all of the turtle species (loggerhead, green, flatback, leatherback, hawksbill) and cetaceans & dugongs.

Capture

Seasnakes – Summary

ERA Risk Rating (C0 L5 NEGLIGIBLE)

Seasnakes are occasionally caught in the fishery but are generally returned to the water in a live state. Most species are considered to be abundant or common in Exmouth Gulf and are not known to be vulnerable. The full rationale for the negligible risk rating for seasnakes is documented in section 5.2.1.1.

Syngnathids – Summary

ERA Risk Rating (C1 L2 LOW)

Syngnathids are incidentally caught in the EGP fishery and are generally removed from the codend dead. Results from an observer program for prawn trawl fisheries on the west coast suggests that very low numbers of syngnathids are caught, in the order of 1 per night across the entire fleet. The full rationale for the negligible risk rating for syngnathids is documented in section 5.2.1.2.

Leatherback Turtles – Summary

ERA Risk Rating (C0 L5 NEGLIGIBLE)

Leatherback turtles are quite uncommon in Exmouth Gulf. There have been no reported captures of leatherback turtles in the trawl gear for the EGP fishery spanning the 40-year history of the fishery. For full details see 5.2.1.3.

Green Turtles – Summary

ERA Risk Rating (C0 L5 NEGLIGIBLE)

Green turtles are the most abundant turtle species in the Exmouth Gulf. Over the 40-year history of the fishery, however, there have been very few reported captures of green turtles. The turtles that were caught are returned alive to the water and observed swimming away. For further information see Section 5.2.1.4.

Loggerhead Turtles – Summary

ERA Risk Rating (C1 L4 LOW)

Loggerhead turtles are incidentally caught by the EGP fishery and are less common than green turtles in Exmouth Gulf. Although, there have been very few reports of captures over the 40 year history of the fishery, the relatively long tow times for this fishery may increase the risk of death for loggerhead turtles caught in the gear. However the introduction of BRD grids should eliminate this as an issue. For more details see Section 5.2.1.5.

Flatback Turtles – Summary

ERA Risk Rating (C0 L5 NEGLIGIBLE)

Exmouth Gulf is at the southern limit of the flatback turtle's distributional range therefore they are relatively uncommon. With the introduction of BRDs to the fishery in 2002 and 100% BRDs in 2003, this will effectively prevent the capture of any turtle in the fishery. For further information see Section 5.2.1.6.

Hawksbill Turtles – Summary

ERA Risk Rating (C0 L5 NEGLIGIBLE)

Hawksbill turtles are relatively uncommon in Exmouth Gulf. There have been no reported captures of hawksbill turtles in the trawl gear over the 40-year history of the fishery. For full details see 5.2.1.7.

Interactions but no capture

Dugongs & Cetaceans – Summary

ERA Risk Rating (C1 L3 LOW)

There has been no evidence or record of a dugong capture or interaction over the period of the fishery, which is in excess of 40 years. For full details see Section 5.2.2.1.

Leatherback Turtles - Summary

ERA Risk Rating (C0 L5 NEGLIGIBLE)

Leatherback turtles are quite uncommon in Exmouth Gulf. Since leatherback turtles feed primarily on jellyfish, they are only likely to occur in Exmouth Gulf following a jellyfish aggregation. Regardless, due to the relatively low vessel speeds it is highly unlikely that any leatherback turtles would come into contact with the vessels itself or the gear being trawled. For full details see Section 5.2.2.2.

Green Turtles – Summary

ERA Risk Rating (C0 L5 NEGLIGIBLE)

There have been no reports of green turtles interacting with trawl vessels, although they are the most abundant turtles in Exmouth Gulf. This is probably due to the fact that trawls are excluded from and/or avoid the preferred habitat of green turtles, seagrass habitats. Regardless, due to the relatively low vessel speeds it is highly unlikely that any green turtles would come into contact with the vessels itself or the gear being trawled. For full details see Section 5.2.2.3.

Loggerhead Turtles – Summary

ERA Risk Rating (C1 L4 LOW)

Loggerhead turtles are relatively less common than green turtles in Exmouth Gulf. Although loggerhead turtles are generally found within shallow waters outside of the trawl grounds, they also forage over open substrate such as the mud/shell substrate that dominates the trawl grounds in Exmouth Gulf. Regardless, due to the relatively low vessel speeds it is highly unlikely that any loggerhead turtles would come into contact with the vessels itself or the gear being trawled. For full details see Section 5.2.2.4.

Flatback Turtles – Summary

ERA Risk Rating (C0 L5 NEGLIGIBLE)

Given the preferred diet and foraging behaviour of flatback turtles it is unlikely that they occur on the trawl grounds for the EGP fishery. Regardless, due to the relatively low vessel speeds it is highly unlikely that any flatback turtles would come into contact with the vessel itself or the gear being trawled. For full details see Section 5.2.2.5.

Hawksbill Turtles – Summary

ERA Risk Rating (C0 L5 NEGLIGIBLE)

Hawksbill turtles are relatively uncommon in Exmouth Gulf. Since the hawksbill turtles prefer to forage over hard coral and rock substrate, it is unlikely that the turtles physically occur on the trawl grounds. Regardless, due to the relatively low vessel speeds it is highly unlikely that any hawksbill turtles would come into contact with the vessels itself or the gear being trawled. For full details see Section 5.2.2.6.

2.2.3 There is an assessment of the impact of the fishery on threatened ecological communities.

There are no threatened ecological communities associated with the EGP fishery.

Management Responses

2.2.4 There are measures in place to avoid capture and/or mortality of endangered, threatened or protected species.

As previously mentioned above in 2.1.3, with the introduction of at least two BRDs per boat, in 2002 and four in 2003 by this fishery (for quad gear), it is expected that the quantity and likelihood of bycatch captures will be minimised. Currently, the fleet is trialling BRDs in the form of large grids. In addition, the Department of Fisheries has commenced a survey of bycatch species throughout Exmouth Gulf in order to ensure that bycatch species are adequately represented outside the trawl grounds to ensure sufficient refuge for these species. Data will continue to be collected by fishery dependent means.

2.2.5 There are measures in place to avoid impact on threatened ecological communities.

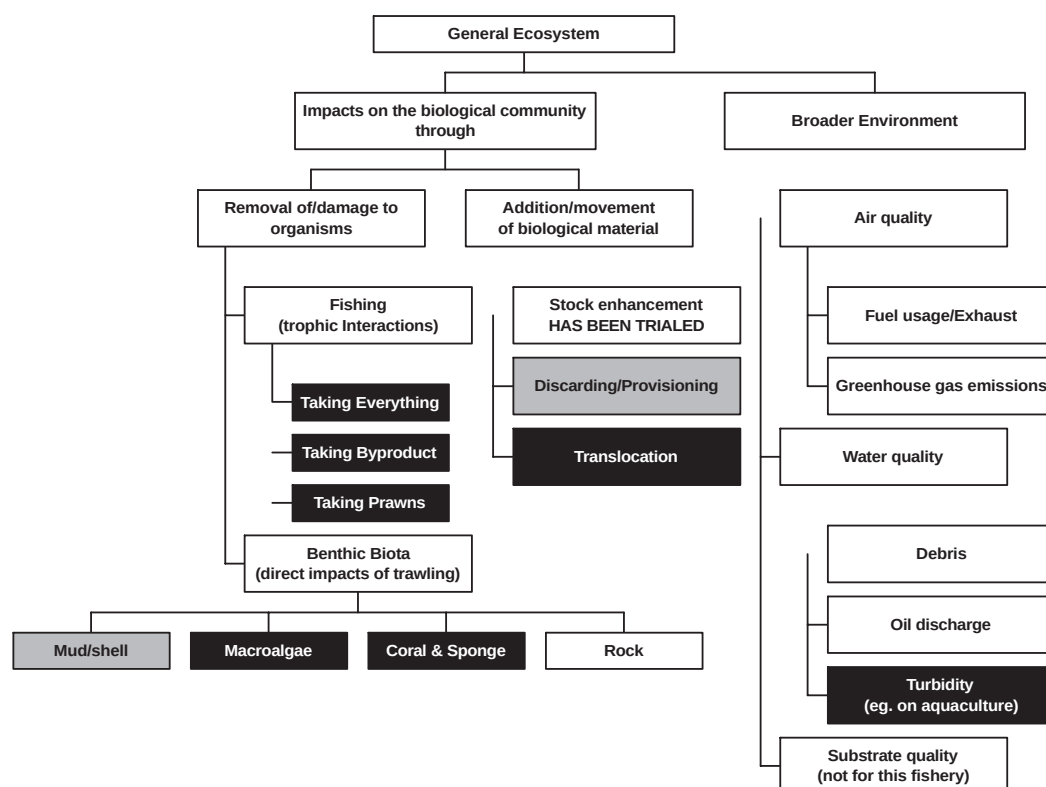
Not applicable.

2.2.6 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

Given the relatively low levels of interactions of the EGP fishery with non-retained species and the introduction of BRDs since 2002, it is highly likely that no unacceptable impacts on these threatened species will result from the EGP fishery. Nonetheless, as monitoring data becomes more available, the suitability of the current performance limits may need to be reviewed. If they are inappropriate and/or the level of interactions increases, appropriate alterations to practices will be taken.

OBJECTIVE 3. GENERAL ECOSYSTEM

The fishery is conducted, in a manner that minimises the impact of fishing operations on the ecosystem generally.



The issues that relate to the broader ecosystem which were identified for the EGP fishery are shown in the following component tree. A formal risk assessment process with the information relating to each issue detailed in Section 5.3.

Of the nine issues identified for the EGP fishery, five were rated as a LOW risk and the other four were rated as a NEGLIGIBLE risk. Consequently, the EGP fishery's current performance is meeting Objective 3 and this acceptable performance is likely to at least continue or improve in the future due to the implementation of further management arrangements.

Information Requirements

2.3.1 Information appropriate for the analysis in 2.3.2 is collected and/or collected covering the fisheries impact on the ecosystem and environment generally.

Appropriate levels of information have been obtained for most of the issues identified, which has allowed for a sensible assessment of the level of risk to be determined. This information includes data collected directly related to the EGP fishery - in terms of the stock assessment and status of prawn stocks, levels of catch and effort, gear designs, and understanding of spatial and temporal closures. There are also a number of research publications that provide valuable evidence on the effects of prawn trawling on sand, seagrass, mud and soft coral communities, and trophic structures in similar fisheries/ environments in other parts of Australia and elsewhere. The use of this information has been critical to the development of appropriate management responses.

In cases where the level of information is insufficient, processes are already in place to remedy this situation to enable a more informed decision to be made (e.g. distribution, composition and abundance of fish and invertebrate species within various habitats in trawled and untrawled areas in the Exmouth Gulf Region). Consequently, the levels of information available for most issues identified allowed a sensible assessment of the level of risk to be determined.

Assessments

2.3.2 Information is collected and a risk analysis, appropriate to the scale of the fishery and its potential impacts, is conducted into the susceptibility of each of the following ecosystem components to the fishery.

A formal risk assessment was completed (see Section 5.3 for details) on each of the identified issues relevant to the EGP fishery (see component tree for issues). The identified issues that were assessed and a summary of the outcomes are located in Table 5 – complete justifications are located in the performance reports in Section 5.3.

Management Responses

2.3.3 Management actions are in place to ensure significant damage to ecosystems does not arise from the impacts described in 2.3.1.

The most important management methods required to ensure that there is minimal impact on the broader ecosystem include maintaining significant biomass levels of prawns and other by-product species. In most cases, this serves to achieve both objectives of having a sustainable fishery and minimising the potential for any trophic interactions. Other management measures such as gear restrictions, spatial and seasonal closures, limiting number of operating vessels, and future research also further minimise the potential for general ecosystem impacts.

With the proposal of future studies to be conducted on the different habitats within Exmouth Gulf and the introduction of the VMS in 2002 an increase of information will be generated to more accurately assess these issues.

Table 5. Summary of risk assessment outcomes for environmental issues related to the EGP fishery.

ISSUES	RISK	SUMMARY JUSTIFICATION	FULL DETAILS
Impact on trophic interactions:			
Impact of taking prawns	Low	Most prawn predators are opportunistic (no prawn-only predators) due to the natural variability of the prawn populations. The fishing mortality of prawns in Exmouth Gulf is relatively low compared to the natural seasonal variability and availability of prawn populations.	5.3.1.1
Impact of taking by-product species	Negligible	Most carnivorous predators are opportunistic and/or scavengers and are not considered dependent on any one species. The by-product species are taken in relatively small quantities and generally have large distribution ranges.	5.3.1.2
Taking of all retained and non-retained species	Low	Spatial and temporal closures ensure that adequate stocks of all species survive. The total removal of biological material by the EGP fishery is not likely to be detectable because Exmouth Gulf is a highly productive region.	5.3.1.3
Impacts on benthic biota:			
Mud/Shell	Low	Studies of actual impacts from prawn trawling suggest only minimal effects on infaunal communities. Mud substrate in the gulf is generally comprised of coarser and heavier sediments and is thought to be more resistant to disturbance from trawling activities. More knowledge may be needed on the spatial distribution of habitats and trawled and untrawled areas in the gulf.	5.3.1.4
Coral/Sponge	Low/Negligible	Trawl grounds and the vulnerable soft coral and sponge habitats are largely separated on a geographical and depth basis. There are no hard coral habitats in the areas where trawling occurs, and few within the Gulf region – these are in the Ningaloo area south of the Gulf.	5.3.1.5
Macro-algal	Negligible	Macroalgal beds are geographically separated from the actual trawl grounds. The majority of these areas are permanent nursery closure.	5.3.1.6

Addition or Movement of Material			
Discarding Fish (Provisioning)	Low	The area over which bycatch are discarded is large and therefore any impacts would be diffused. Introduction of BRDs will reduce the amount of bycatch generated by this fishery, which in turn reduces the amount of discards. More data is needed in terms of the amount of discards per season and ratio of discards to target catch.	5.3.2.1
Turbidity	Negligible	The design of trawl gear is such that it is not in direct consistent contact with the substrate. The water of Exmouth Gulf is regularly turbid as a result of cyclone events.	5.3.3.1
Translocation	Negligible	Vessels in Exmouth Gulf have little interaction with fisheries in other regions. Highly unlikely any transported species would survive long term given the large seasonal variations in water temperature between the north and south of the state.	5.3.3.2

2.3.4 There are decision rules that trigger further management responses when monitoring detects impacts on selected ecosystem indicators beyond a predetermined level, or where action is indicated by application of the precautionary approach.

Most of the issues identified for this category were not of sufficient risk to require specific target levels as they are effectively covered by the other management arrangements and trigger points. For the impacts on the mud/sand and coral/sponge the current spatial distribution of trawling (which is < 40% of the area) is acting to ensure that these habitats are not impacted at unacceptable levels. The current level of discarding was determined to be only a LOW risk to the ecosystem and this is likely to be reduced even further following the introductions of the various BRDs in 2002 and 2003.

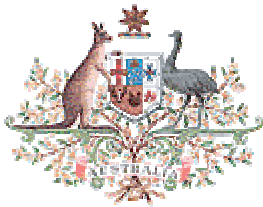
2.3.5 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

The risk assessment identified that under the current management arrangements there have been minimal or negligible impacts from the EGP fishery on the broader ecosystem even after around 40 years of fishing, it is therefore highly likely that the fishery will continue to meet the objectives of having only acceptable levels of impact. If future studies indicate that further management is required for one or more of the various habitat types and the by-product and/or bycatch species, then appropriate actions will be developed.

APPENDIX 9. RECOMMENDATIONS AND APPROVAL FROM EA

Recommendations to the Department of Fisheries Western Australia on the ecologically sustainable management of the Exmouth Gulf Prawn Fishery

1. The ESD report, including all performance measures, responses and information requirements, should be formally incorporated into the management regime and decision making process within one year, with a clear timeframe for implementation.
2. The ESD report should be amended to incorporate time frames for all management responses to breaches of performance measures.
3. A mechanism should be developed to enable the amendment of management arrangements to respond to new information, or future Government plans and policies.
4. EA should be informed of any changes to the management plan or managerial commitments in the ESD report.
5. Opportunity should be provided to conservation, community and recreational fishing interests to participate in the processes of the main advisory body to the WA Fisheries Minister for this fishery. DFWA should also ensure that any relevant indigenous interests are considered through appropriate consultative mechanisms.
6. Permitted byproduct should be limited to species currently harvested with a robust system developed to add or remove species as appropriate. Suitable catch triggers should be developed to ensure any change in targeting behaviour can be detected and addressed as it occurs. Management responses should be clarified, with timeframes for implementation, to address such changes, so that the management arrangements are able to minimise threats to byproduct species.
7. DFWA should participate in any cross-jurisdictional activities regarding relevant target and byproduct species, including squid.
8. Ongoing monitoring should be implemented sufficient to identify long-term trends in bycatch between fished and unfished areas to ensure that information used in the risk assessment for the fishery remains based on accurate and current data.
9. The importance of specific areas and habitats to applicable bycatch species during all stages of their life cycle should be considered when applying the results of the biodiversity research to management arrangements.
10. All protected species interactions by commercial operations should be reported and coupled with an education program to ensure industry has the capacity to make accurate reports.



**THE HON. DR. DAVID KEMP MP
MINISTER FOR THE ENVIRONMENT
AND HERITAGE**

The Hon Kim Chance MLC
Minister for Agriculture, Forestry and Fisheries
11th Floor, Dumas House
2 Havelock Street
WEST PERTH WA 6005

Dear Minister

In November 2001 the Western Australian Department of Fisheries (WADF) submitted the document *Application to Environment Australia for the Exmouth Gulf Fishery Against the Guidelines for the Ecologically Sustainable Management of Fisheries for Continued Listing on Section 303DB of the Environmental Protection and Biodiversity Conservation Act 1999* for assessment under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The submission has been assessed in accordance with the wildlife trade provisions of Part 13A of the EPBC Act.

I am pleased to advise that assessment of the fishery is now complete. The assessment report will be available on the EA website at: <http://www.ea.gov.au/coasts/fisheries/index.html>.

I am satisfied that for the purposes of the wildlife trade provisions in part 13A of the EPBC Act, the management arrangements provide the basis for the fishery to be managed in an ecologically sustainable way. I therefore propose to amend the list of exempt native specimens, to include all specimens taken in the Exmouth Gulf Prawn Fishery, for a period of five years. Such listing will serve to exempt the fishery from other export controls of the Act and exempt exporters from requiring export permits under the Act.

The Exmouth Gulf Prawn Fishery management arrangements meet the Commonwealth's *Guidelines for the Ecologically Sustainable Management of Fisheries*. The fishery is managed under a comprehensive, adaptable, precautionary and ecologically based regime capable of controlling, monitoring and enforcing the level of take from the fishery. The combination of management arrangements, data gathering and research commitments provides confidence in the fishery's ability to manage impacts on the wider ecosystem.

While there are some environmental risks associated with this fishery, I believe that DFWA is taking a proactive approach to mitigating these risks and addressing them adequately. Officers from our two departments have discussed some key areas requiring ongoing attention. I understand that they have agreed to a number of recommended actions, focussed on ensuring the continuation of good management practices. The recommendations, attached to this letter, have been an important factor in my decision to exempt the fishery and I look forward to receiving your agreement to implement these recommendations.

I would like to thank you for the constructive way in which your officials have approached this assessment and I look forward to reviewing the remainder of the Western Australian managed fisheries.

Yours sincerely

Signed on 12 March 2003

DAVID KEMP